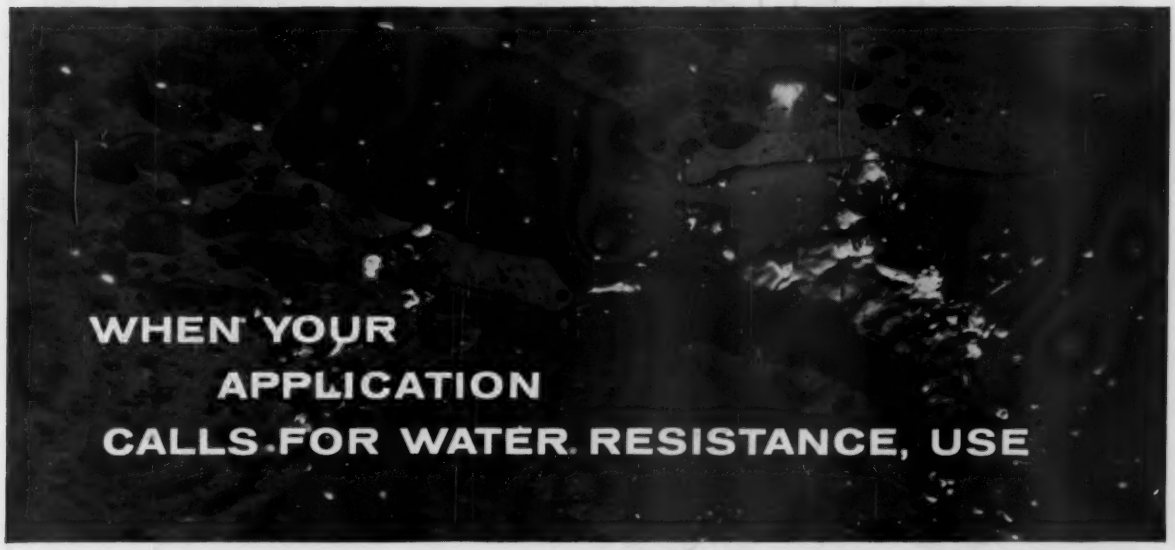
News about

B.F.Goodrich Chemical *raw materials*



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Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

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833 **Rubber-Based Adhesive for Polyurethane**
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*Appears every other month

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Highlights Sidelights *of the News . . .*

February, 1960

The Big Four of the rubber industry — Firestone, Goodyear, Goodrich and U.S. Rubber — all face labor negotiations this spring . . . Present company contracts with the United Rubber Workers have until April-June 1961 to run, but they may be reopened a year earlier . . . The contract terms and wage provisions cover more than 80,000 rubber workers (page 846).

The Small Business Subcommittee of the House of Representatives heard testimony on alleged pay-offs between major rubber and oil companies to obtain servicing business at filling stations . . . One witness claimed that such sales agreements were hurting the smaller tire producers . . . However, a recent Federal Trade Commission finding absolved three large tire firms from charges of coercing station operators (page 847).

United Carbon has formed a French subsidiary to open a $5 million carbon black plant near Rouen in 1961 . . . Initial production will be of higher grade reinforcing blacks at a 50 million pound annual rate . . . The location in central France was chosen for its economic potential and access to raw materials (page 852).

Trading on two General Tire & Rubber preferred stocks was suspended by the New York Stock Exchange because too few shares were publicly held to warrant further listing . . . Only 60 and 130 stockholders remained for the two issues, respectively . . . Other common and cumulative preferred stock of the company was not affected by the action (page 846).

Motorists are likely to find a new word added to their car vocabularies next winter . . . "Tractionized" tires are being introduced by Goodyear to improve stopping and traction on snow-covered and slippery roads . . . The process consists of making thousands of small holes in the surface of the tire tread (page 857).

The ACS Division of Rubber Chemistry has announced plans for its spring meeting May 4-6 in Buffalo, N. Y. . . . Dr. W. B. Wiegand will receive the Goodyear Medal for his carbon black research . . . Professor P. Debye, a Nobel Prize winner in chemistry, will speak on polymer physics, Professor H. Mark on polymerization chemistry . . . Papers are being invited for four technical sessions (page 846).

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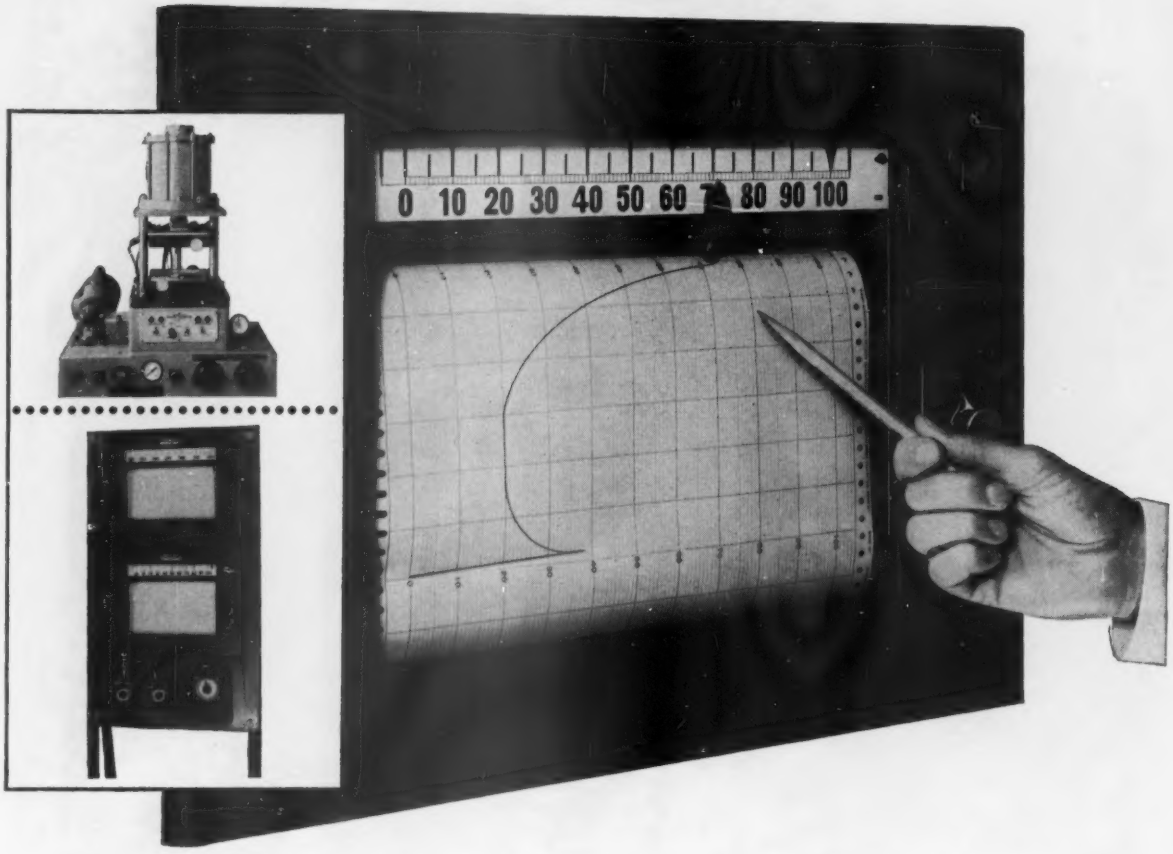

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More information on PLIOFLEX —the many types available and how they might help you—yours by writing Goodyear, Chemical Division, Dept. N-9419, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

Plioflex—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Photo taken through the courtesy of Charleston Rubber Company, Charleston, S. C.

Chemigum gives protection with a "plus"

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If you can use an outstanding oil- and chemical-resistant rubber with outstanding processing properties, it will pay you to learn more about CHEMIGUM. For complete information–including latest *Tech Book Bulletins*–write: Goodyear, Chemical Division, Dept. N-9419, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

Chemigum – T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

Photo courtesy Globe Rubber Products Corporation, Philadelphia, Pa.

Fashion floor that's built for kicks

Spiked heels may be stylish on the foot, but they're "murder" on floors. Car floors, particularly, take a beating – not only from the pointed fashions of modern footwear, but from the constant pounding of foot-loose youngsters.

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Want proof? Just look at the clean, crisp color of the floor mat above. Consider, too, the assured processability of PLIOFLEX *plus* its high uniformity and exceptional resistance to aging.

It all adds up to economical production of a sales-appealing product. To add appeal to *your* product without adding to your costs, check the advantages of PLIOFLEX. For full information–plus latest *Tech Book Bulletins* on PLIOFLEX and a full range of synthetic rubbers and rubber chemicals–write Goodyear, Chemical Division, Dept. N-9419, Akron 16, Ohio.

GOODYEAR

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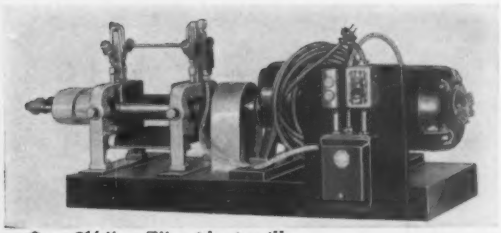
Pliofilex–T. M. The Goodyear Tire & Rubber Company, Akron, Ohio



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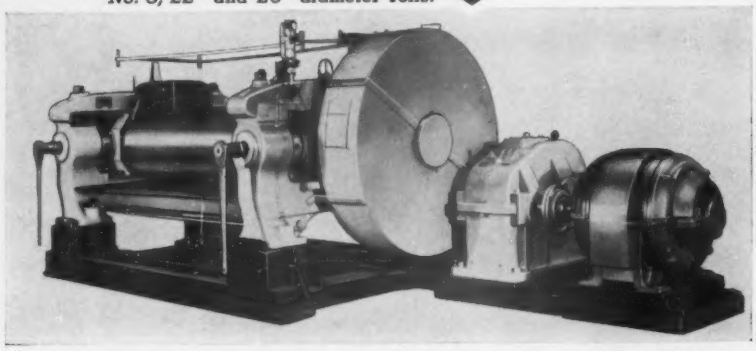

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News in Brief

► An eight-page brochure containing comparative data on three calcined clays for the rubber industry, is available from J. M. Huber Corp., New York, N. Y. The brochure presents the physical and chemical properties of Polyfil 40, Polyfil 70 and Polyfil 80, and shows the relative reinforcing effects in four rubber polymers at four different loading levels.

► A copy of the revised national standards for treading automobile and truck tires can be obtained from the Tire Retreading Institute, a division of the National Tire Dealers and Retreaders Association, Washington, D. C.

► The Rubber Manufacturers Association, New York, N. Y., has published a 40-page booklet entitled "The Care and Service of Truck Tires." The booklet covers correct inflations of tires, load distribution, effect of heat, rapid tread wear, driving habits, tire rotation, rims, tubes, safety precautions and methods of repair.

► Chemical Division of the Goodyear Tire & Rubber Co., Akron, Ohio, has published a six-page index listing the *Tech Book Facts* issued by the Rubber Chemicals Department through August, 1959. The company has published 11 *Tech Book Facts* since distribution of the index. These contain data on Plioflex 1508, 1500C, 1712C, 1006, 1502, 1507, 1713, 1714C, 1773, 1778, and Chemigum N600.

► Midwest Rubber Reclaiming Co. has been judged as having the best annual report of the rubber industry by an independent board of judges in the Nineteenth Annual Report Survey by *Financial World* magazine.

► The Tenth Edition of *American Men of Science* is now in preparation and will contain biographies of more than 130,000 living Americans and Canadians, who are actively contributing to the advancement of science. The edition will be published in five parts on an accelerated four-year cycle. Any eligible scientist who has not submitted a biographical sketch should contact Jacques Cattell, editor, American Men of Science, Arizona State University, Annex 15, Tempe, Arizona.

► Members of the National Association of Waste Materials Dealers, Inc., have voted to change the name of the organization to National Association of Secondary Materials Industries, Inc.

► Goodrich-Gulf Chemicals, Inc., has leased 15,200 square feet of floor space on the 12th floor of the new East Ohio building in Cleveland, Ohio.

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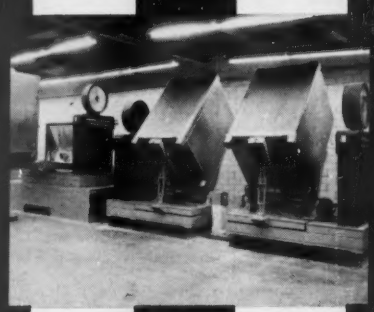

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coming events

Feb. 18. Washington Rubber Group, Technical Meeting, Washington, D. C.

Feb. 19. Connecticut Rubber Group, Technical Symposium, Waverly Inn, Cheshire, Conn.

Feb. 21-24. American Institute of Chemical Engineers, National Meeting, Biltmore Hotel, Atlanta, Ga.

Feb. 24-26. American Management Association, Special Conference on Planning New Products, Drake Hotel, Chicago, Ill.

Feb. 25. National Bureau of Standards, Division of Organic and Fibrous Materials, Lecture Series on High Polymers, Materials Testing Laboratory, Washington, D. C.

Feb. 25-26. National Wiring Bureau, Sales Conference, Warwick Hotel, Philadelphia, Penna.

Feb. 26. Quebec Rubber & Plastics Group, Ladies' Night Dance, Victoria Hall, Montreal, Quebec, Canada.

Feb. 29-March 4. Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy & Exposition of Modern Laboratory Equipment, Penn - Sheraton Hotel, Pittsburgh, Penna.

March 1. Buffalo Rubber Group, Spring Meeting, Hotel Westbrook, Buffalo, N. Y.

March 1. Los Angeles Rubber Group, Technical Meeting, Biltmore Hotel, Los Angeles, Calif.

March 1-4. American Society for Testing Materials, Committee D-13 on Textile Materials, Spring Meeting, Sheraton-Atlantic Hotel, New York, N. Y.

March 4. Akron Polymer Lecture Group, University of Akron, Akron, Ohio.

March 6-11. Tenth International Toy & Trade Fair, Hotel Statler Hilton, New York, N. Y.

March 7-16. American Toy Fair, Hotels New Yorker and Sheraton-Atlantic, New York, N. Y.

March 9-11. Instrument Society of America, Temperature Measurement Symposium, Deshler-Hilton Hotel, Columbus, Ohio.

March 10. Northern California Rubber Group, Elks Club, Berkeley, Calif.

March 10-13. Pacific Automotive Show, City Auditorium, Denver, Colo.

March 11. Chicago Rubber Group, Technical Meeting, Furniture Club, Chicago, Ill.

March 12-15. National Association of Waste Material Dealers, 47th Annual Convention, Waldorf-Astoria Hotel, New York, N. Y.

March 14-18. National Association of Corrosion Engineers, National Meeting, Dallas, Texas.

March 15-21. Third International Conference on Non-Destructive Testing, Tokyo, Japan.

March 16. Washington Rubber Group, Ladies Night, Washington, D. C.

March 17. National Bureau of Standards, Division of Organic and Fibrous Materials, Lecture Series on High Polymers, Materials Testing Laboratory, Washington, D. C.

March 17. Quebec Rubber & Plastics Group, Technical Meeting, Queen's Hotel, Montreal, Quebec, Canada.

March 18. Boston Rubber Group, Technical Meeting, Somerset Hotel, Boston, Mass.

March 23-24. Commercial Chemical Development Association, Annual Meeting, Plaza Hotel, New York, N. Y.

March 24-25. Textile Research Institute, Annual Meeting, Hotel Commodore, New York, N. Y.

March 25. New York Rubber Group, Spring Meeting, Henry Hudson Hotel, New York, N. Y.

March 26. Fourth Annual Symposium on Recent Advances in Programming Methods, Ohio State University, Columbus, Ohio.

March 29-31. American Society of Mechanical Engineers, American Power Conference, Sherman Hotel, Chicago, Ill.

March 30-31. Plastics Institute Conference on Polymeric Progress, William Beveridge Hall, London University, London, England.

March 30-April 1. Canadian Tire Dealers Association, Annual Meeting, Montreal, Quebec, Canada.

March 31-April 1. American Society of Mechanical Engineers, Textile Engineering Conference, North Carolina State College, Raleigh, N. C.

April 1. Akron Polymer Lecture Group, University of Akron, Akron, Ohio.

April 3-6. National Toy Show, Morrison Hotel, Chicago, Ill.

April 3-8. Sixth Nuclear Congress & Exhibit, New York Coliseum, New York, N. Y.

April 4-7. 1960 Nuclear Congress, New York Coliseum, New York, N. Y.

April 5. Los Angeles Rubber Group, Technical Meeting, Biltmore Hotel, Los Angeles, Calif.

April 5-14. American Chemical Society, 137th National Meeting, Cleveland, Ohio.

April 7. Rhode Island Rubber Club, Spring Meeting, Pawtucket Country Club, Pawtucket, R. I.

April 8. Akron Rubber Group, Technical Symposium, Sheraton Hotel, Akron, Ohio.

April 8. Chemical Institute of Canada, Rubber Division, Annual Conference, Walper Hotel, Kitchener, Ontario, Canada.

April 8-9. Society of the Plastics Industry, 17th Western Section Conference, New Riviera Hotel, Palm Springs, Calif.

April 9-26. Fourth Osaka International Trade Fair, Osaka, Japan.

April 12-27. Milan Trade Fair, Milan, Italy.

April 14. Fort Wayne Rubber & Plastics Group, Technical Meeting, Van Orman Hotel, Fort Wayne, Ind.

April 14. Northern California Rubber Group, Elks Club, Berkeley, Calif.

April 18-19. Conference on Automatic Techniques, Sheraton Cleveland Hotel, Cleveland, Ohio.

April 19. Association of Consulting Chemists & Chemical Engineers, Forum Meeting, Hotel Shelburne, New York, N. Y.

April 20. Quebec Rubber & Plastics Group, Technical Meeting, Queen's Hotel, Montreal, Quebec, Canada.

April 20. Washington Rubber Group, Field Trip to Kelly-Springfield Plant, Cumberland, Md.

April 22. Chicago Rubber Group, Technical Meeting, Furniture Club, Chicago, Ill.

April 22. Detroit Rubber & Plastics Group, Spring Meeting, Detroit Leland Hotel, Detroit, Mich.

April 24-May 3. German Industries Fair, Hanover, West Germany.

April 25-26. American Society of Mechanical Engineers, Maintenance and Plant Engineering Conference, Chase and Park Plaza Hotels, St. Louis, Mo.

April 25-26. Society of the Plastics Industry (Canada), 18th Annual Canadian Section Conference, London Hotel, London, Ontario, Canada.

May 4-6. Division of Rubber Chemistry, American Chemical Society, Spring Meeting, Statler Hotel, Buffalo, N. Y.

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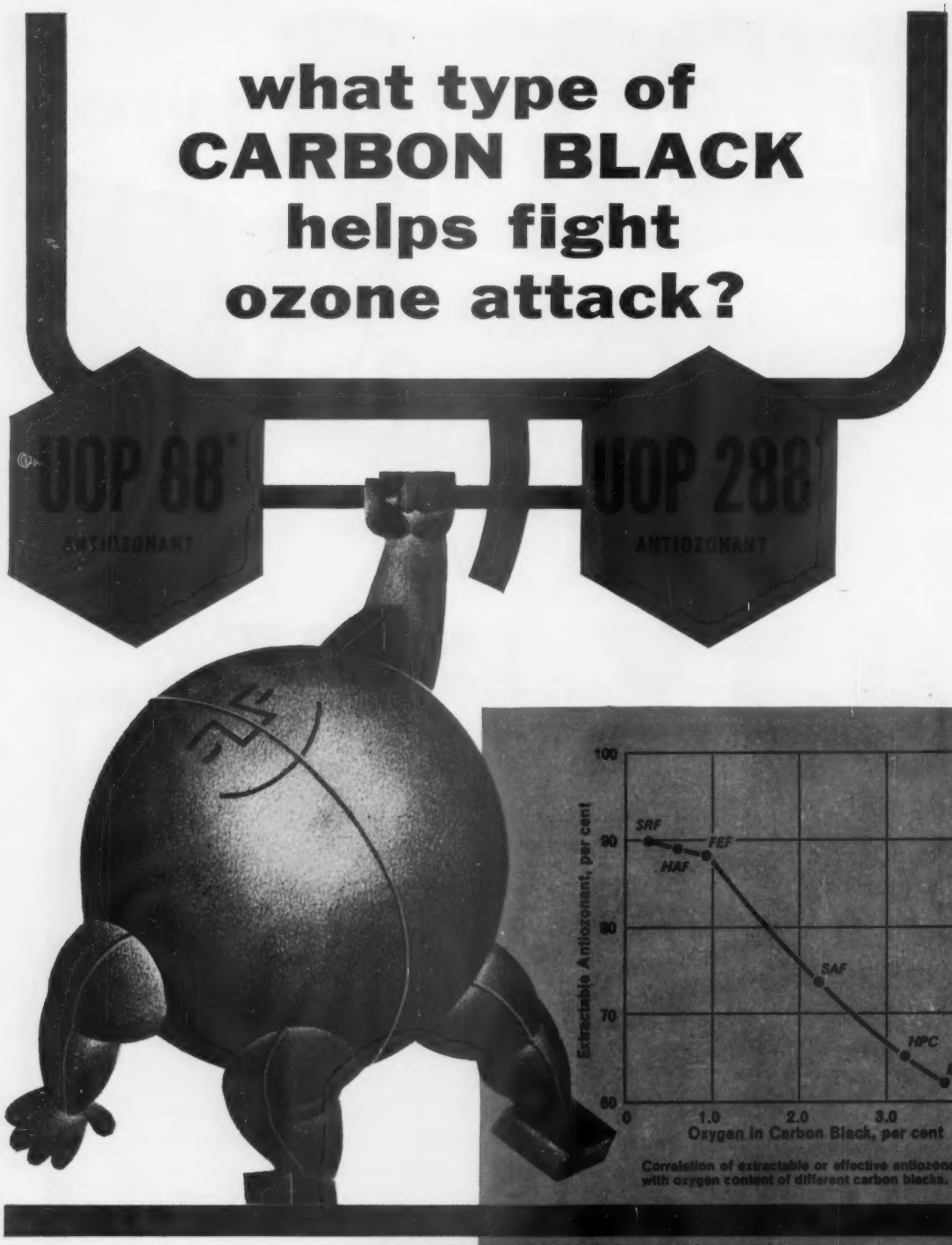
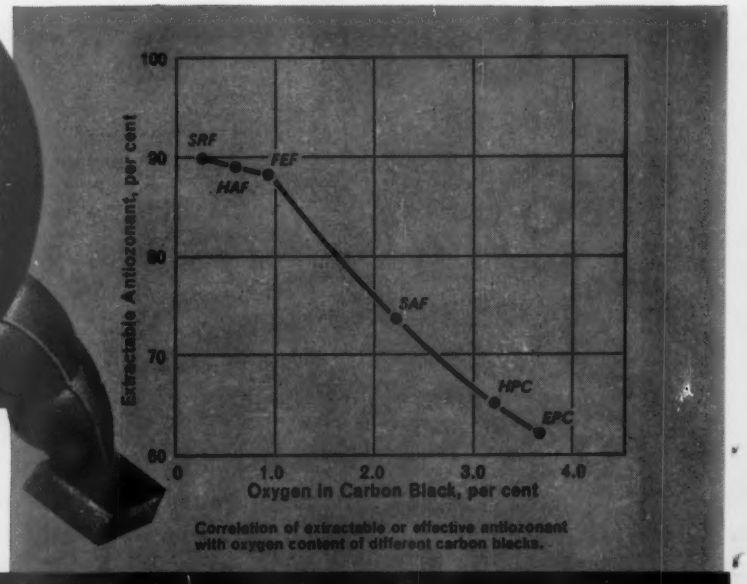
DIVISION **BORG-WARNER** WEST VIRGINIA

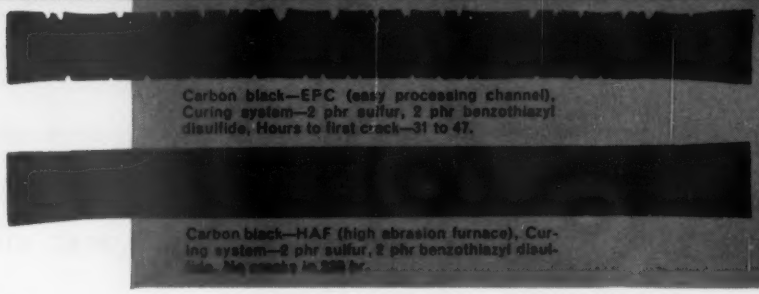
what type of CARBON BLACK helps fight ozone attack?





Correlation of extractable or effective antiozonant with oxygen content of different carbon blacks.

The SBR specimens at right were exposed to ozone at 100° F, 20 percent elongation, 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.



Carbon black—EPC (easy processing channel). Curing system—2 phr sulfur, 2 phr benzothiazyl disulfide. Hours to first crack—31 to 47.

Carbon black—HAF (high abrasion furnace). Curing system—2 phr sulfur, 2 phr benzothiazyl disulfide. No cracks in 239 hr.

the kind you choose can be a help or a hindrance . . .

Are you aware of the extent to which some carbon blacks adversely affect the protection afforded rubber products by antiozonants?

Some inactivate much of the antiozonant added for ozone protection. Others are more compatible with the antiozonant. How this affects the ozone resistance and hence the service life of rubber is well illustrated by the chart and table below. Even more dramatic than the figures presented is the difference in condition of the two rubber test strips shown at lower left.

Here is clear evidence that carbon black plays an extremely important part in obtaining maximum service life of rubber compounded with antiozonants.

In formulating rubber compounds which must have high resistance to ozone, look to Universal for assistance. Special facilities and technical personnel are available to serve you. Write or telephone our Products Department.

CARBON BLACK TYPE AND ANTIOZONANT EFFECTIVENESS

Carbon Black	Approximate Areas, sq m per g	pH	Per Cent Oxygen in Black	Per Cent UOP 88 Extractable from Vulcanizate	Hours to First Crack of Vulcanizate 100 F—50 pphm Ozone		
					Elongations		
					25 Per Cent	20 Per Cent	15 Per Cent
None...	...	...	...	97.1	>336	>336	>336
MT.....	7	7.4	...	92.2	>336	>336	>336
FT.....	18	7.2	...	91.6	>336	>336	>336
SRF....	30	9.4	0.37	89.9	>336	>336	>336
HAF....	70	9.2	0.71	86.6	>336	>336	>336
FEF.....	40	9.3	0.87	87.9	>336	>336	>336
ISAF...	100	9.1	...	80.8	>336	>336	>336
SAF....	~140	...	2.21	74.5	>336	>336	>336
HPC....	~160	4.9	3.23	64.3	3	6	16
EPC....	110	4.3	3.71	61.9	2	2	6

The table above shows how carbon black type affects extractable antiozonant, which in turn affects ozone resistance of rubber. Note that rubber stocks containing a low percentage of oxygen show high extractable antiozonant, and consequent long life under conditions of high ozone concentration and stress.

To cover all phases of service conditions, UOP rubber labs conduct dynamic and static tests both indoors and outdoors:

To evaluate any service problem, test formulations are carefully compounded in this rubber mill by trained UOP technicians.

DeMattia flexer is used to evaluate flex-cracking properties of compounds tested in UOP rubber laboratory.

Test specimens mounted on outdoor racks are examined at regular intervals for evidence of deterioration.

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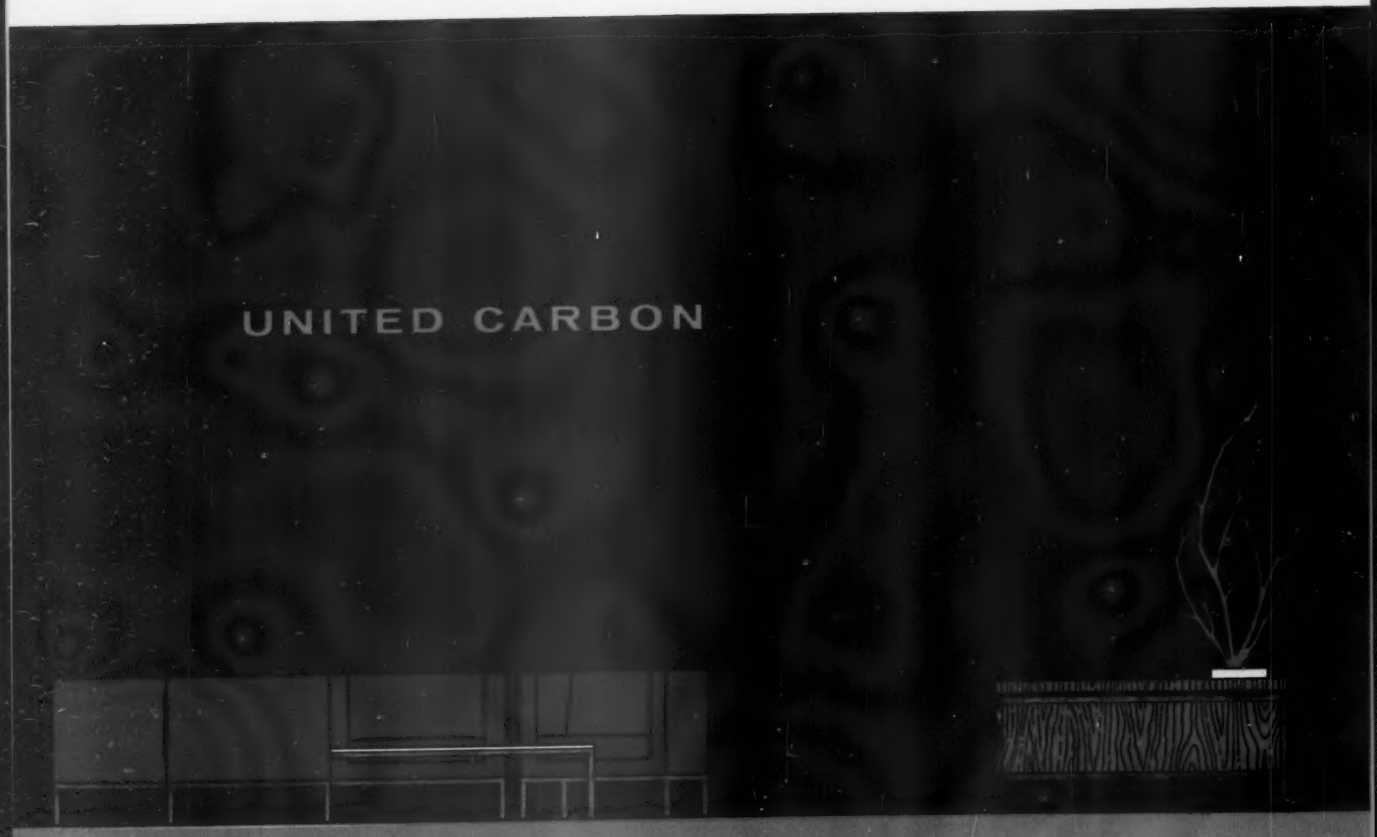
30 Algonquin Road, Des Plaines, Illinois, U.S.A.



In the past nine months there have been major personnel re-alignments and several technical facility and office relocations—all directed toward broadening United's services to its customers. Recently we had the pleasure of announcing the locations of our new home offices and our marketing headquarters. It is my privilege now to introduce our new Marketing Group and our district sales managers. We look forward to serving you with faster deliveries, finer technical service and ever improving products.

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Director of Marketing

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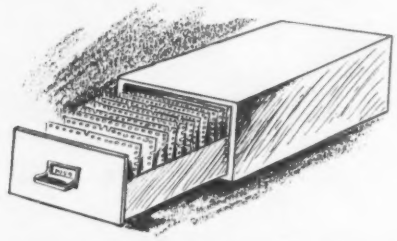

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SHELL

capitol cues

POLITICS AND ECONOMY WILL DOMINATE CONGRESS in the year that is just getting under way. It will be a short and hectic session, producing very little in the way of legislation of importance to businessmen. Next Fall's elections will be occupying the mind of virtually every lawmaker. Members of both parties will want to wind up work in a hurry to start campaigning.

Every major issue that does come up faces two important tests:

- First, will it be popular? Will it attract votes for members who back the bill? The Congressmen will want to know if it will help them win re-election and with the White House race.
- Second, will it be costly? Neither the Republicans nor their opposition want to be blamed for upsetting a balanced Budget.

These pressures make it hard for party leaders to find catchy issues. Too often, vote-getting programs are very expensive.

This dilemma will be toughest on the Democrats. They already are walking a precarious tight-rope, trying to be "the party of the people" without being tagged by the GOP as spenders.

THE DEMOCRATS WILL BE FORCED TO RELY ON TWO KEY THEMES as this session goes along. Foreign policy is one. In this field, they will challenge the Administration on Ike's approach to Russia; they will also criticize the GOP for missile lags and push for more aid to underdeveloped countries. And on a second front—domestic policy—Democrats will campaign against tight money and charge that today's credit policies hurt the economy and small business. The Democrats also will make much of programs to help consumers and farmers.

POLITICS WILL SHOW UP IN VOTES ON THE NEW BUDGET—the one that is being submitted for the 1961 fiscal year, which begins next July 1. The Budget will end up balanced—that much is sure. It will even show a respectable surplus. A group of liberal Democrats will still press for expensive programs in the field of education, social security, aid to depressed areas, etc. But Ike's vetoes and the "fiscal responsibility" of Democratic leaders will block them.

In the end, the President's Budget may end up $1 billion or so higher than he asks. But part of the hike will reflect things beyond any control—higher farm payments, higher interest rates on the national debt, etc. Tax revenues may well be somewhat higher than estimated, which would still leave a tidy surplus.

LABOR LEGISLATION MAY AGAIN BE A BIG CONCERN of Congress, particularly if a national rail strike adds to the damage done by the steel walkout. The legislators had felt that, with the passage of last year's sweeping law, they would be through with labor-management problems for some time to come. They won't want to do anything on labor on an election year—that's clear. But the President feels that the economy can't be subjected to another strike such as it took last Fall—a buffeting that cost billions of dollars in lost output. So, depending on developments, Congress may be forced to vote new labor laws.

capitol cues (cont'd)

THE PRESIDENT WANTS TO HOLD SPENDING TO $80 BILLION during the next fiscal year. By the time Congress gets through, though, the figure may be up to around $81.5 billion. As for revenue, the President hopes for something in the neighborhood of $83 billion. But good business could lift income as high as $85 billion. So, the surplus will run at least $2 billion and could go up to $3 billion. In the current fiscal year, spending will come out to around $78.9 billion, with total tax revenues only about $200 million less.

Here's how the money will be spent in the coming fiscal year:

- For defense, the Budget will attempt to match this year's $41 billion—more for missiles and space and less for planes.
- For foreign aid, Ike wants $4 billion in new money, but sharp cuts will be made. Backlogs of unspent money, though, will keep spending high. Military assistance will be emphasized.
- For agriculture, Ike wants to keep outlays under the figure for this year. But good crop weather would upset this hope.

New programs and some recently started will account for hikes in the Budget. These include air traffic controls, pensions for war widows, new health insurance for U. S. workers, etc.

There aren't any big decreases in federal programs in the new Budget. And Congress won't go for some revenue saving plans—higher postal rates, loading some jobs on the states, etc.

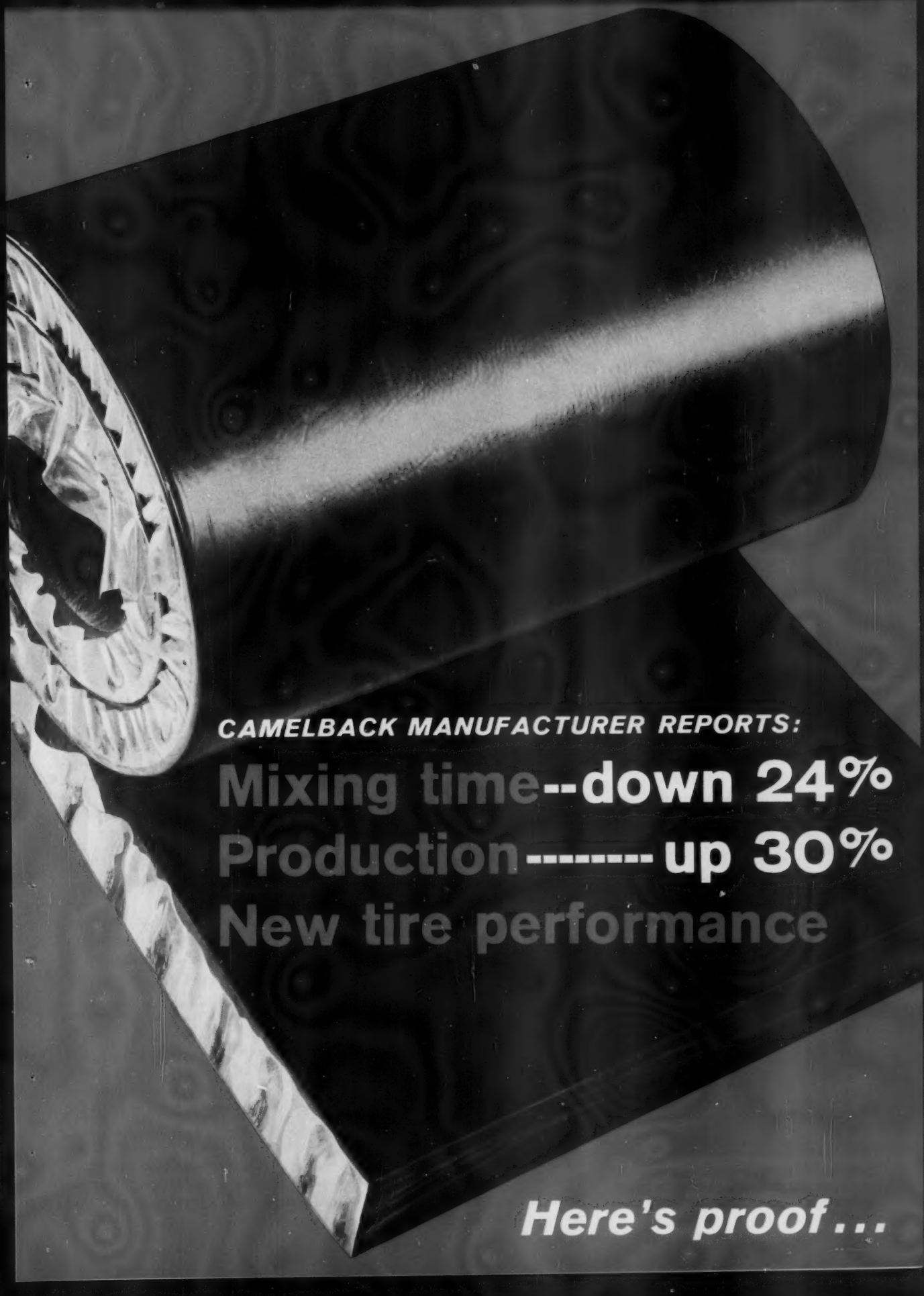
CHANCES OF A TAX CUT FOR INDIVIDUALS ARE NOT BRIGHT for this session, although Congress will make some important revisions and adjustments in law. Generally good business has killed one of the greatest arguments for cutting rates. And Eisenhower would rather use the surplus to cut the federal debt.

Here's how Congress probably will deal with specific tax bills:

- The Keogh bill, to give the self-employed deductions for funds placed in their own pension plans, has a fair chance. It has already passed the House and is now in the Senate. Treasury opposition is the big hurdle. Eisenhower may sign it, anyway.
- Corporate taxes will be continued for another year at the 52% rate. Excises also will be extended at the high Korean rate.
- Depletion allowances will get a lot of attention. There'll be efforts to cut the rate but nothing is expected in 1960.
- Patronage dividends of co-ops may be taxed—to the patrons.
- Union and trade group dues will be an issue, prompted by the efforts of Internal Revenue to deny exemption when the funds are used for lobbying. Congress will block the IRS campaign.

THERE WILL BE BIG DRIVES TO SPUR HOME-BUILDING during the 1960 session. Some Congressmen already are concerned about shrinking prospects for housing, and others will join as time goes on and mortgage money gets tighter. There will be a strong Democratic push for a new $500 million program to finance government purchases of mortgages on low-cost homes. Such a program would get 500,000 units built. Ike will oppose the plan; the final vote will be close.

The democrats want to expand the college-housing loan program. Ike, instead, wants government guarantees for private lenders, but he may go along with the Democrats. Other programs, for slum clearance and housing for the aged, etc., won't get far.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Edward Malone, General Manager of Washington Rubber Company, checks the gauge uniformity of extruded camelback.

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Washington Rubber finds another processing advantage in the greater tensile strength of Micro-Black masterbatch. Says Mr. Malone, "Tensile strength of milled rubber is 3600 psi compared with 3200 psi for the rubber previously used—indicating superior dispersion of carbon black—and a constant Mooney viscosity is obtained. We get more uniform rubber gauge at the extruder and production volume is greater with far less reject material."

Customer reaction is excellent. "Retread shops tell us that our camelback made with Ameripol Micro-Black is giving wear performance equal to that of new tires. This is the result of improved dispersion of carbon black in the latex, possible only with Goodrich-Gulf's jet stream agitation process," Mr. Malone states.

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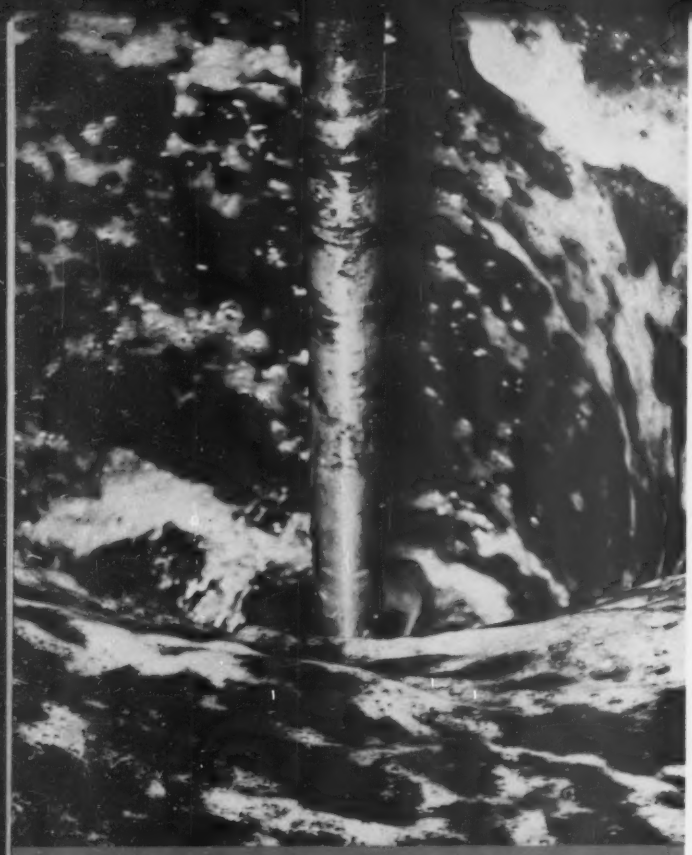
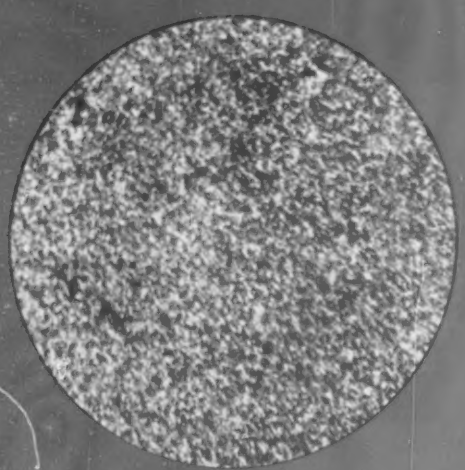
According to one of Anchor Tire's customers, a truck rental agency, this extra mileage pays off. The manager states, "To operate efficiently, recaps have to give us a minimum of 30,000 miles service. If they don't —back they go to the supplier for a rebate based on the difference between 30,000 and the actual mileage. Figuring the cost per mile of an average truck tire at $.00065 a mile, doubling tread life is like getting a new tire free."

Anchor Tire Company produces retreads that last as long as new tires, with camelback processed with Ameripol Micro-Black.



High liquid-shear agitation of carbon black in the latex slurry gives Ameripol Micro-Black controlled uniformity and better wearing qualities.



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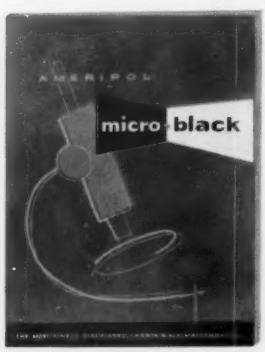

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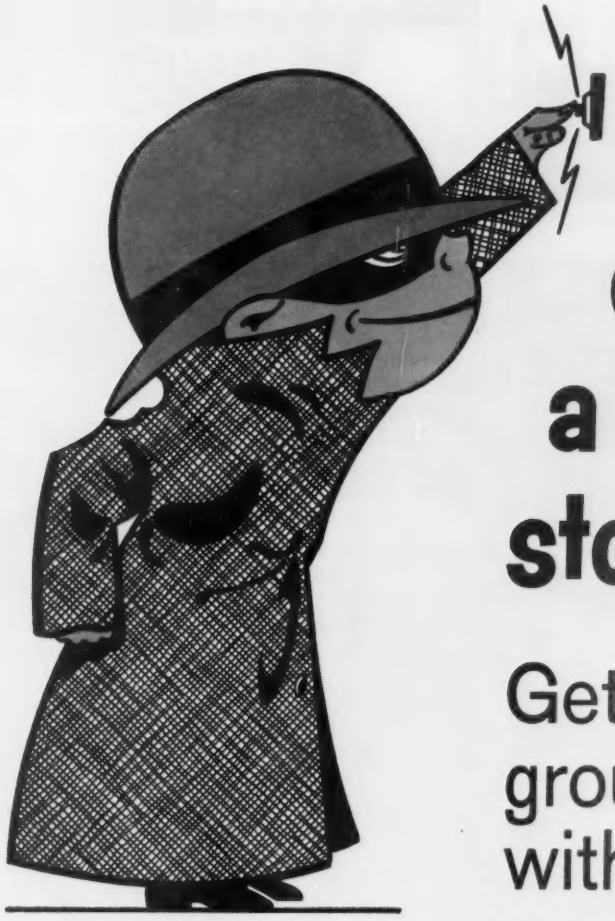

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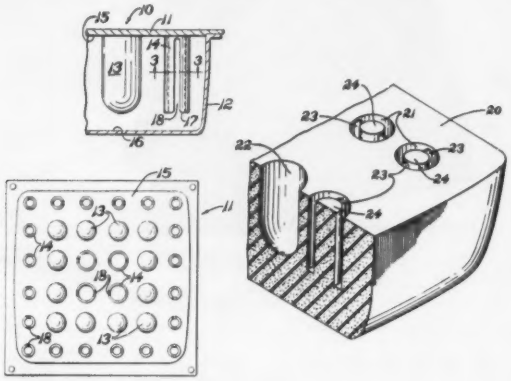
PATENT REVIEW

by Melvin Nord

Foam Rubber Mold

U. S. Patent 2,901,773, issued Sept. 1, 1959 to Anselm Talalay, assigned to B. F. Goodrich Co., relates to the molding of foam rubber articles having cavities or cored portions, such as cushions or mattresses.

In such products as mattresses, furniture cushions, automobile seat cushions and the like, it is usually desirable to have marginal areas of the constructions firmer than other areas and capable of supporting greater loads. If cavities or cored portions of conventional shape are formed in such marginal areas close to the edges of the structure, the marginal areas do no have the desired firmness. Consequently, it has been consid-



ered necessary to form the marginal areas of such products of uncored material in order to obtain a firm border edge. However, the absence of coring in the parts of the molded foam rubber sections forming the marginal areas of the finished product creates difficulties in manufacture.

The uncored areas require a longer time to vulcanize than cored areas; as a result, the foam rubber of the article is not vulcanized uniformly. Furthermore, if the foamed rubber is to be frozen during the coagulation process, a longer time is required for freezing, which raises the cost of manufacturing. The present invention provides a mold having novel coring pins, of a configuration permitting marginal areas to be cored without encountering the above difficulties.

As shown in the diagrams, upper section (11) of mold (10) is provided with pins (13 and 14) which project from the bottom face (15) of the mold section into the cavity when the mold is closed. These pins form the cavities or cored por-

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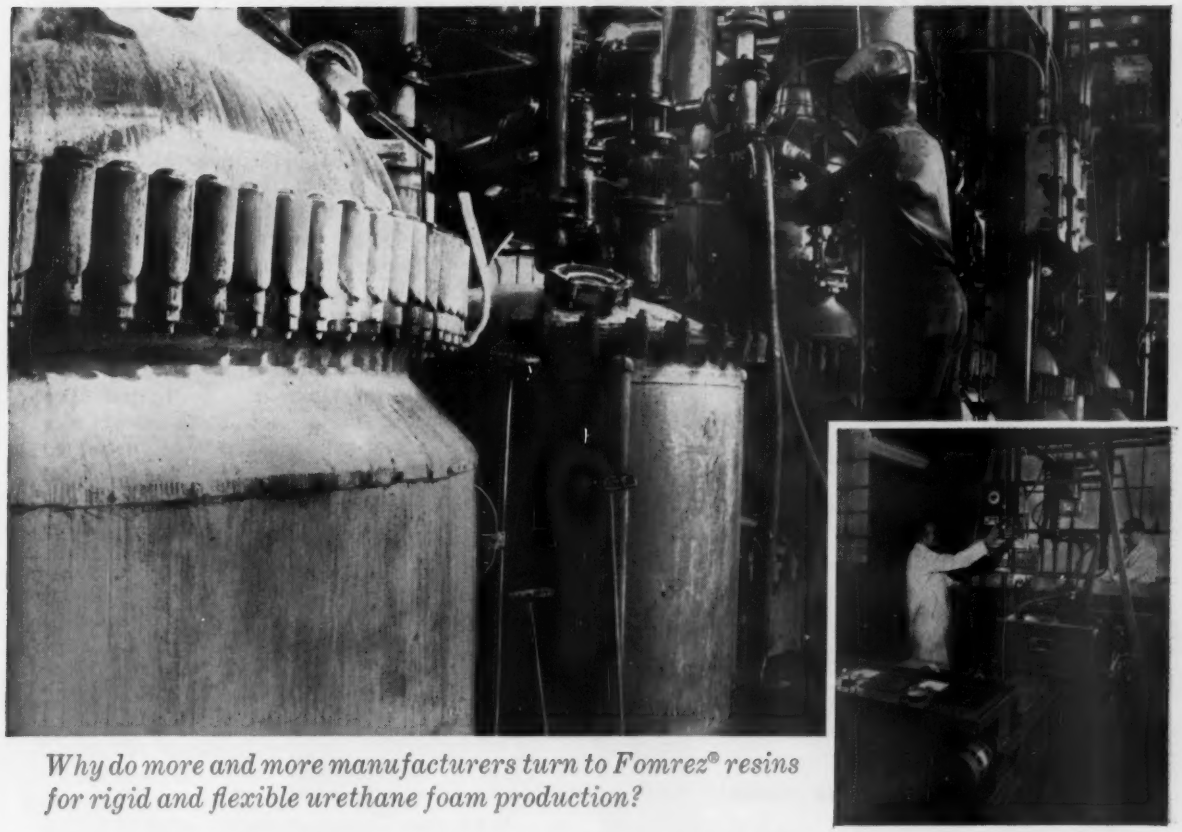

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PATENT REVIEW

tions in the molded foam rubber article. They are arranged in a systematic pattern, generally in aligned or staggered rows.

Pins (13), of conventional design, form cavities corresponding in shape to the external surface of the pins. They core those areas of the foam rubber article in which normal firmness is desired. Hollow pins (14) are used for coring those areas in which greater firmness is desired than is possible by coring with pins of conventional construction. It is essential to this invention that pins (14) be hollow, open at least at the end which projects into the cavity of mold (10), and project only part way through the cavity, not to or through the top face (16) of mold section (12).

A foam rubber article (20) formed in mold (10) is shown in the diagram on the right. Cavities (21) were cored with pins (14) of mold (10), while cavity (22) was cored with a conventionally shaped pin (13). Each cavity (21) has essentially the same shape as the pin (14) which formed it. Furthermore, each consists of a generally annular cylindrical opening interrupted by webs (23) of foam rubber, extending parallel to the longitudinal axis of the opening and connecting the foam rubber externally adjacent to cavity (21) with the core (24) of foam rubber.

Rubber-Lignin Coprecipitates

U. S. Patent 2,890,183, issued June 9, 1959 to Henry E. Haxo Jr. and George S. Mills, assigned to United States Rubber Co., provides a method of enhancing the abrasion resistance of vulcanizates of lignin-synthetic rubber mixtures, without impairment of other physical properties.

It has been found that marked enhancement of the abrasion resistance of substantially water-free coprecipitated mixtures of lignin and synthetic rubbery diolefin polymers is effected by heat treating in the presence of certain aldehydes, at a temperature of at least 300° F. for a substantial period of time.

Silica-Reinforced Rubber Stocks

U. S. Patent 2,892,807, issued June 30, 1959 to John W. Sellers and Melvin P. Wagner, assigned to Columbia-Southern Chemical Corp., relates to specially prepared siliceous pigments for incorporation into rubber stocks to improve wear resistance, as well as tensile, tear, and modulus properties.

The siliceous pigments are finely divided hydrated silica having particle sizes below 0.1 micron, and a surface area of 25-250 square meters per gram.

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PATENT REVIEW

Chlorinated Rubbery Copolymers

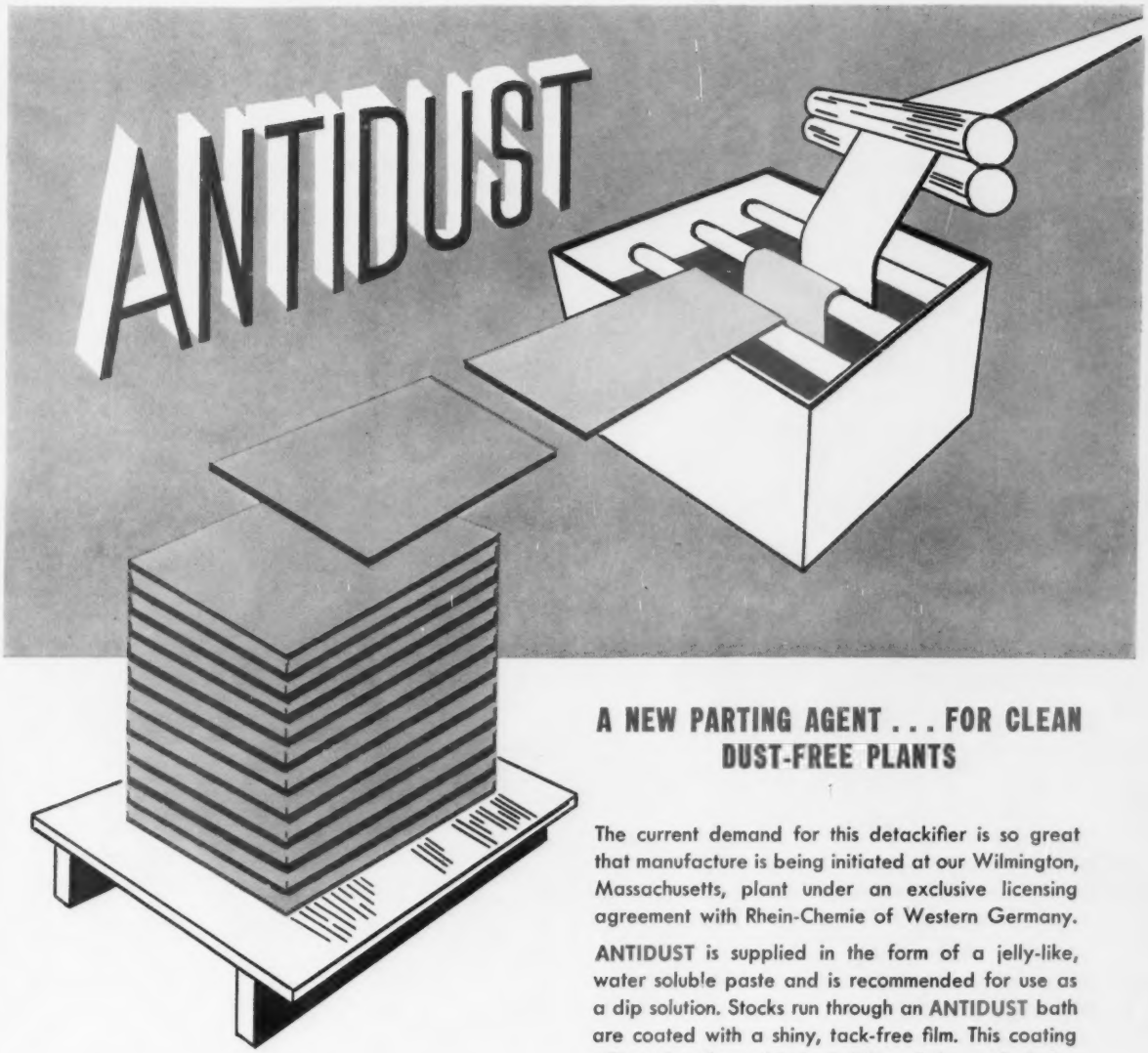
U. S. Patent 2,891,595, issued June 23, 1959 to Irving Kuntz, Elroy J. Inchalik, and Theodore P. Lamiszka, assigned to Esso Research and Engineering Co., relates to the preparation of chlorinated rubbery copolymers.

Butyl rubber is reacted with a minor proportion of chlorine. The reaction product is further modified by reaction with aluminum alcoholates to improve tensile strength, modulus, and such hysteresis characteristics as dynamic modulus, internal viscosity and relative damping.

Other Patents of Interest

Subject	Inventor or Assignee	Patent No.	Date
Sealers for joints	U. S. Rubber Co.	2,899,876	8/18/59
Safety tire construction	Goodyear Tire & Rubber Co.	2,900,005	8/18/59
Anti-ozone agent for white rubber products	Monsanto Chemical Co.	2,900,358	8/18/59
Substituted xylenols as antioxidants	Goodyear Tire & Rubber Co.	2,900,362	8/18/59
Bagless vulcanizing press	Adolf H. Frohlich et al	2,901,771	9/11/59
Polyurethane tire	Mobay Chemical Co.	2,902,072	9/11/59
Tire construction	B. F. Goodrich Co.	2,902,073	9/11/59
Tire tread transfer apparatus	B. F. Goodrich Co.	2,902,082	9/11/59
Manufacture of tire beads	National-Standard Co.	2,902,083	9/11/59
Siloxane-silicate elastomers	Dow Corning Corp.	2,902,467	9/11/59
Sealing composition	E. I. du Pont de Nemours & Co.	2,903,437	9/18/59
Tire vulcanizing equipment	Ottis S. White	2,903,741	9/15/59
Apparatus for making corrugated flexible rubber tubes	Thermoid Co.	2,903,744	9/15/59
Anti-skid device for tires	Ray L. Kroon	2,904,093	9/15/59
Tire bead construction	U. S. Rubber Co.	2,904,095	9/15/59

Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.



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Polymer			Polymer—100 pts.
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PROPERTIES			
CHEMICAL	**Specifications**	**Specifications**	**Tentative Specifications**
Volatile Matter % wt.	0.50 (Max.)	0.75 (Max.)	0.75 (Max.)
Ash % wt.	1.50 (Max.)	1.50 (Max.)	0.50 (Max.)
Organic Acid % wt.	4.00–6.25	4.75–7.00	3.90–5.70
Soap % wt.	0.75 (Max.)	0.50 (Max.)	0.50 (Max.)
Bound Styrene % wt.	22.5–24.5	22.5–24.5	22.5–24.5
Stabilizer % wt.	1.25 added	1.25 added	1.25 added*
PHYSICAL	**Specifications**	**Specifications**	**Typical Properties**
Raw Viscosity, ML-4′–212° F.	44–52	46–58	56
Cpd. Viscosity, ML-4′–212° F.	73 (Max.)	73 (Max.)	52
Tensile psi 50′	2500 (Min.)	3100 (Min.)	2550
Elongation % 50′	500 (Min.)	575 (Min.)	520
Modulus psi 25′	325–625	350–650	700
Modulus psi 50′	750–1100	775–1125	1100
Modulus psi 100′	1200–1600	1250–1650	1350

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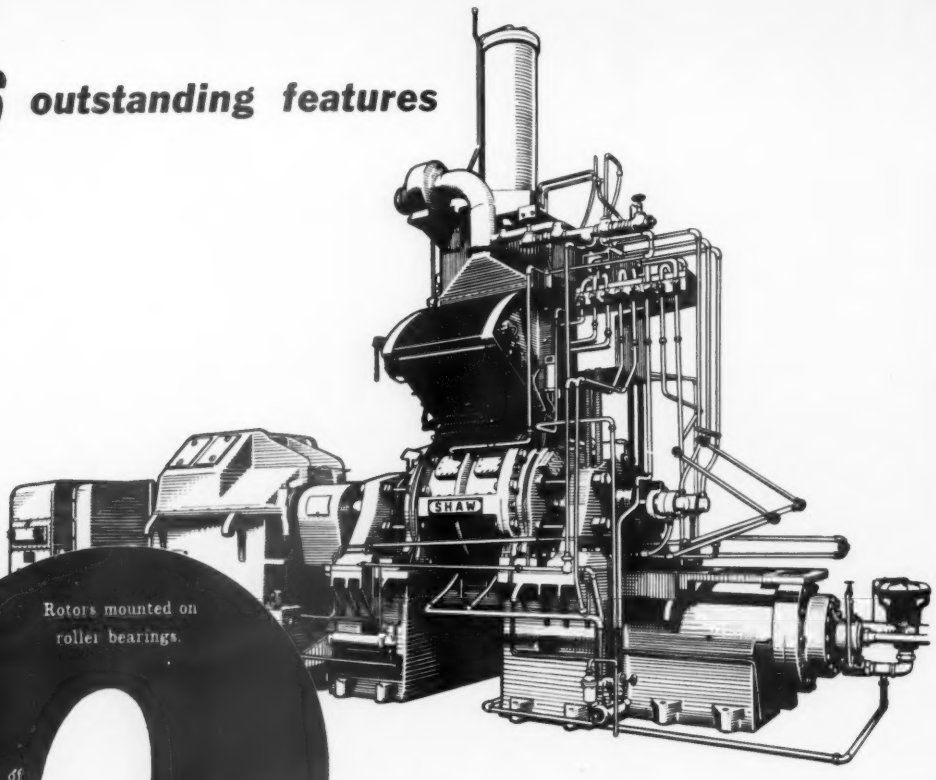

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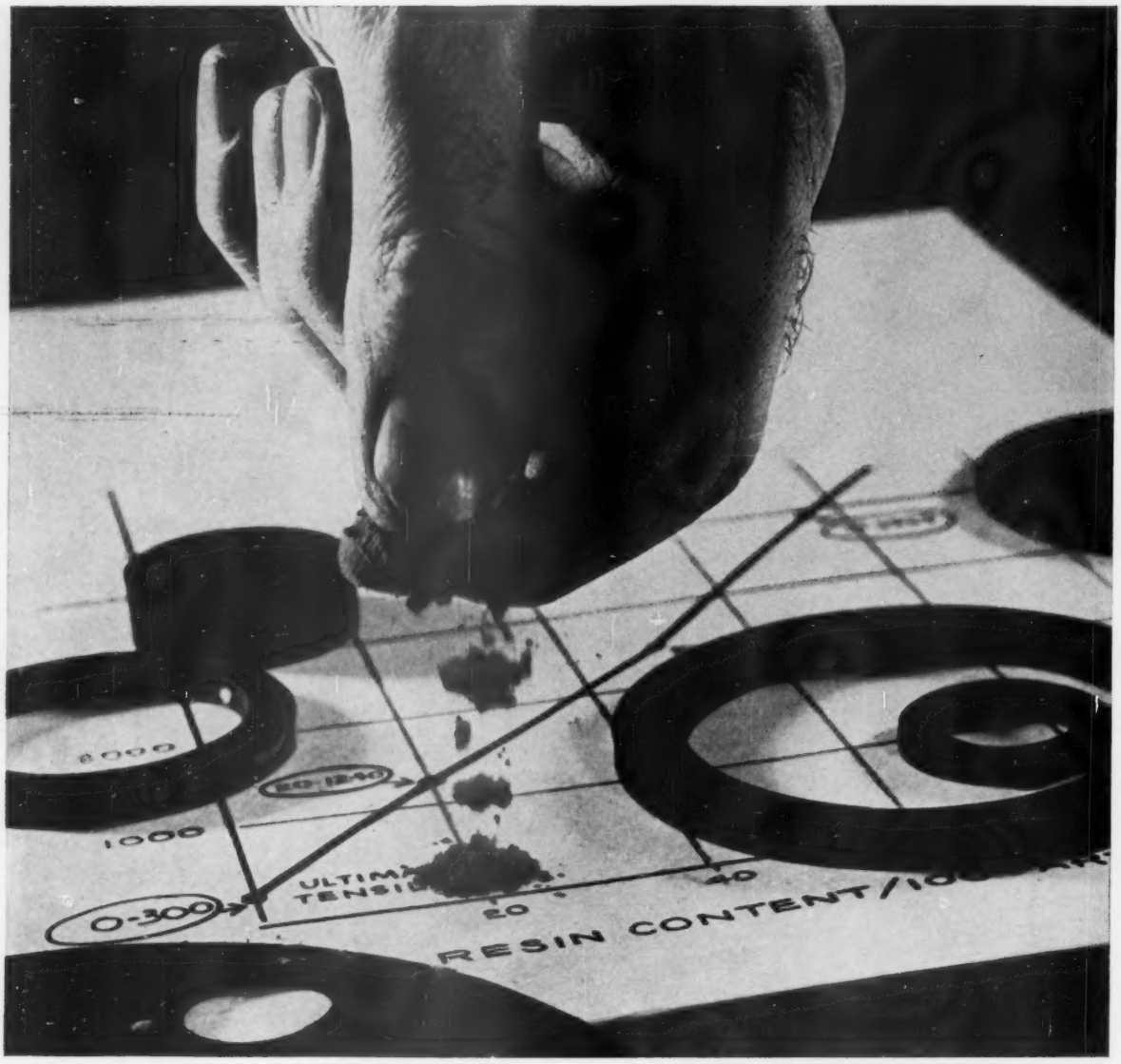

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As Soule Sees It...

by Kenneth J. Soule

Keeping Dry

The Quartermaster Research and Engineering Center, Natick, Mass., has just developed a treatment for making fabrics water repellent, which is said to give much better results than anything presently on the market. As reported in *Chemical & Engineering News* on December 21, 1959, the Quarpel process uses a combination of two standard waterproofing materials, neither of which is adequate alone, as far as resistance to repeated dry cleaning or washing is concerned. However, when properly combined, the blend imparts permanent water resistance to fabrics.

One of the materials used is stearamidopyridium chloride, which is commonly employed in Zelan type treatments. The other is Minnesota Mining and Mfg. Co.'s Scotchgard FC154, a non-ionic emulsion of a perfluoracrylic ester. As outlined, the Army process uses standard equipment and regular methods of application, such as drying, curing, washing, etc. The cost of the treatment is said to be about ten cents per yard higher than present processes.

The Army claims that fabric treated by the Quarpel process will resist the equivalent of a continuous, one-inch-per-hour rainfall for seven days without leaking. Also, it is oil resistant, and both its oil resistance and water repellency are unharmed by laundering or dry cleaning "for the life of the garment."

If these claims stand up in more extensive field and service tests, it could well be that the new process might offer very serious competition not only for other types of fabric treatment, but also for rainwear made of rubber or plastics. It is questionable how much use the Army will make of the process, since as usual, their warehouses are probably bulging with a ten-year-supply of uniforms and raingear of all types made to present standards. However, the process is said to be "public information," and thus freely available to anyone, so some commercial applications should not be too long in putting in an appearance.

Raincoats may then become passé, but at least for a few months you will have to keep on hollering at junior to wear his slicker when he goes outdoors in threatening weather.

Graphite Fibers and Fabrics

To describe a piece of cloth as being made up entirely of graphite fibers seems like some sort of a joke, or at best a contradiction in terms. For how could it conceivably be possible to produce either a fiber, or a piece of fabric from our old acquaintance graphite, which, as everyone knows, exists as a black, smudgy powder or a collection of dark shiny flakes?

Well, the answer to that question and to the seeming enigma lies in the fact that there are now two distinct kinds of graphite, the well known natural variety, and the comparatively new synthetic or man-made type. And it is the latter class which can be furnished as a fiber or in many of the conventional textile forms such as braids, felts and various knitted or woven fabrics.

A number of companies, including Pittsburgh Coke and Chemical, Atomic Labs, and Barneby-Cheney have developed carbon fibers, but it appears that National Carbon (a division of Union Carbide) has progressed beyond the carbon stage, to that of synthetic graphite fibers. This has been done electrically by heating a fiber, such as rayon to a temperature of about 5400° F., which converts the material to graphite with purity of 99.9 per cent while maintaining the fiber form. Incidentally, National Carbon has applied for patents on the method.

Although, as previously mentioned, it is possible to produce a wide variety of fabrics from the new graphite fibers, for the time being the only style available is a square weave cloth with a thread count of 28 by 28 and a thickness of approximately 0.024 inch. Lengths of up to 7 feet by a width of 40 inches are obtainable on an experimental basis at a tentative price of $7.50 per square foot. Other constructions can and will be made as the demand dictates.

Because of the unusual heat and chemical resistance of the basic graphite fiber, it is anticipated that the material will find extremely wide and important use in many military and industrial applications. These might include valve packings and gaskets for jet engines, equipment to handle hot and/or corrosive liquids and gases, and as a strength member in plastics operating at high temperatures. It seems quite likely, too, that the unusual electrical and thermal conductivity of this latest form of carbon will prove very useful in a host of other applications, at present still in the testing stage.

This all goes to prove that whoever it was who is reputed to have said that there is nothing new under the sun should have given up philosophizing a little earlier. As for the rest of us we would do well to have a wide open mind for the "unbelievable." The way the world moves, that word will soon be obsolete!

Flexible Foams

A relatively few short years ago "tree rubber," was used exclusively in the production of what was then known as sponge rubber. Later on, GRS was used to stretch out the rubber supply. Today vinyls, urethanes, and butadiene-styrene polymers (such as Goodyear's No. 5352) have become individual and intense competitors in the field. The end products incidentally, are largely described as being made of flexible foam, rather than sponge.

Although an endless number of products have been, and are being made of these foam materials, the three highest potential outlets most actively pursued are furniture cushioning, mattresses for the bedding trade, and seat cushions and allied items for the automobile indus-

As Soule Sees It (Cont'd)

try. The decision as to which type of foam to select for a given end use must be a most difficult one to make, since the merits of a given product depend not only on the material itself, but equally on its density, as well as the shape and contour of the parts in question. Resiliency, aging, and compression set are other important matters to be considered, and finally comparative price must be taken into account.

A glance through the technical and commercial literature demonstrates beyond question that the final choice of the number one foam for the large scale items mentioned above is yet to be made. Either that, or the home town Madison Ave. boys are still in there trying.

For example, the publicity releases covering the decision of one large furniture manufacturer to use molded vinyl foam in several of its living room suites call this type of material "the newest and most comfortable of all foam cushioning elements." The small-print explanations of these claims are rather vague and inconclusive, being a mixture of generalizations regarding durability, coolness, non-inflammability and economy. In fact, price is mentioned much more often than any other feature.

On the other hand, Goodyear's press notices about their all-synthetic foam rubber "5352" definitely feature reduced costs compared with other commercially used natural rubber foams. Prominent mention is also made of the uniformity, the "excellent compression characteristics, good resilience and great durability" of 5352 foam products. Prices are said to be competitive with items of vinyl and urethane.

As for urethane foam, the present product appears to be satisfactorily competitive, price-wise, while boasting the possession of a number of impressive physical properties. These include "incomparable comfort, resistance to skidding (of fabric covers), light weight, strength, design versatility, etc."

Whether or not the type of foam used in a given piece of furniture, mattress, or automobile seat cushion would be a determining factor in the ultimate buyers' make or model choice, is somewhat questionable at this time. However, it is quite possible that massive consumer tests in themselves could cast the final vote, and automatically decide which foam will finally wind up in the Number One spot.

Thus, 1960 can be the year of decision in the flexible foam race, as well as in the United States presidential arena. And if you want to imply any similarity between the contests because each might involve volumes of hot air, that choice is up to you.

Early Golf

Although the exact origin of the game of golf is lost in the pages of unrecorded history, new versions of how and where the tools used were developed continue to come to light.

The latest of these accounts occurs in a German book by Hans Leip entitled "The Gulf Stream Story." As quoted from the book, by *Rubber Journal and International Plastics* on December 19, 1959, young Scotch fishermen played the game using odd shaped pieces of driftwood as clubs to bang a "ball" around rough seaside courses. While for a "gouf" ball, use was made of the more-or-less round seeds of *Entada scandens*, an enormous plant belonging to the pea family, whose pods are as much as three feet long. These seeds, also known as "sea kidneys," or Moluca beans, originated in Mexico or the Antilles, and were carried to Scotland as well as other European shores by the waters of the Gulf Stream. In some cases, the round beans were hollowed out and filled with feathers, which is said to have given the drives more distance.

Much later, the Scotch, under King James VI, brought the game to England and from there, its ultimate spread to the rest of the world was only a matter of time.

Refinement and standardization of clubs, balls, and other items gradually took place until the game finally reached its present-day status. Basically, however, we are not so far from the crooked stick fishermen walloping a recalcitrant ball around a rugged bit of scenic out doors. And at times, it seems that some of us might do just about as well if we had our Scotch ancestors' equipment instead of our own collection of precision clubs, and beautifully molded rubber and gutta percha balls. But, of course, it only *seems* that way, for a fleeting moment!

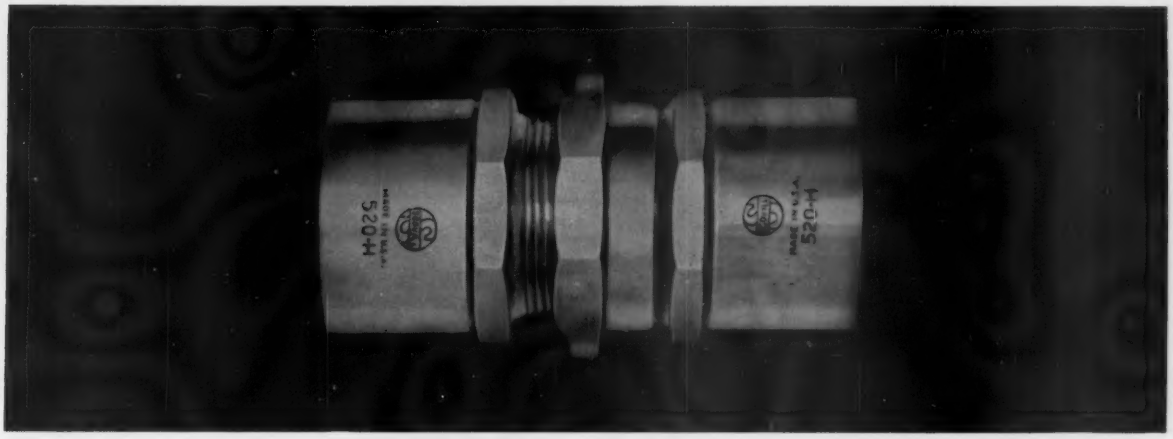
Last Minute-Flashes—Stone-Cutter

A small picture in one of the technical journals portrays a well-protected operator shaping a section of one of the granite piers of the Queensborough Bridge, New York City, using a Linde Oxweld FSP-6 cutting torch. The burner uses oxygen and kerosene, and is said to be much faster than conventional methods for carving stone.

It is not made clear whether or not honest-to-goodness sculpture can be achieved by the use of this tool. Therefore, all of you budding Michelangelos are advised to retain your mallets and chisels, pending clarification of this point.

Year-Round Auto Coolant

Dow Chemical announces a new auto cooling system liquid, called Dowgard, to be released on a nationwide basis in April, 1960. The product consists of about 50 per cent each of deionized (triple purified) water and ethylene glycol, with minimal parts of diethylene glycol and special inhibitors. It is intended for year-round use, and when so employed is said to reduce automobile cooling system corrosion practically to zero. The liquid is harmless to gaskets, hoses and other rubber parts. The cost of Dowgard, when installed in the user's car, will be about one-third higher than regular permanent antifreeze. How quickly its claimed merits will sell it to the motoring public remains the $65 question.



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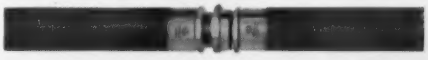

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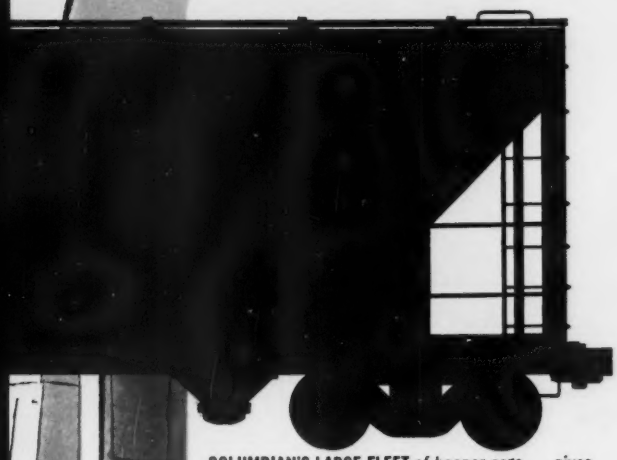

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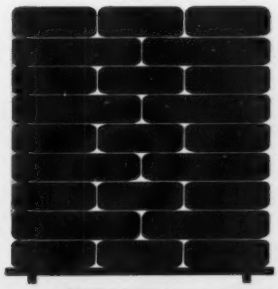

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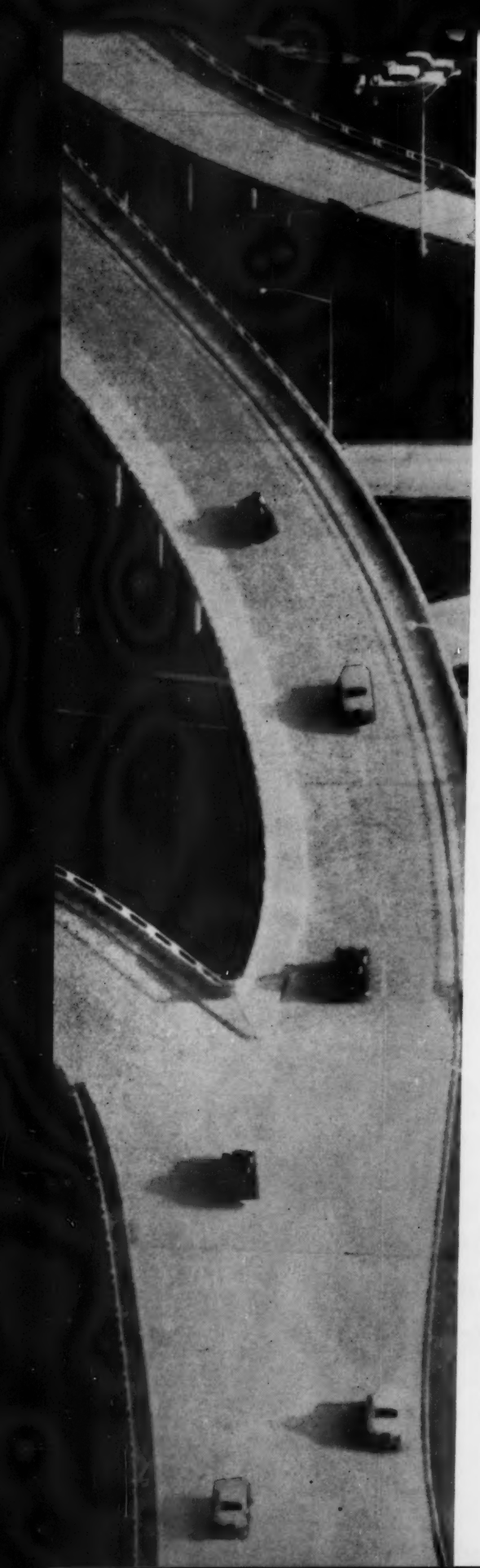

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A cover-to-cover translation of the monthly Russian rubber journal, "Kauchuk i Rezina". Prepared by the Research Association of British Rubber Manufacturers, in collaboration with Maclaren and Sons, Ltd. Distributed exclusively by Rubber Age in the Western Hemisphere. Deals with the efficient use of raw material, the automation of manufacturing processes in the rubber industry and improvements to the design of tires and industrial rubber goods. Articles describing the most important chemical research of interest to the rubber industry are also included.

Although it has been obvious in recent years that Soviet rubber technology and research is very vigorous and highly advanced, it has been extremely difficult because of the language barrier for those in Western countries to follow the technical progress being made there. This, in spite of the fact that the Russian rubber journal is a prolific source of original literature on the subject.

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Action of ionizing radiation on cable rubbers.
Properties of stocks and vulcanizates based on brominated butyl rubber.
The compatibility of polyisoprene with other types of rubber and the effect of this compatibility on bond strength.
Efficiency of the zinc salt and disulfide of trichlorthiophenol in reclaiming rubbers by the neutral method.
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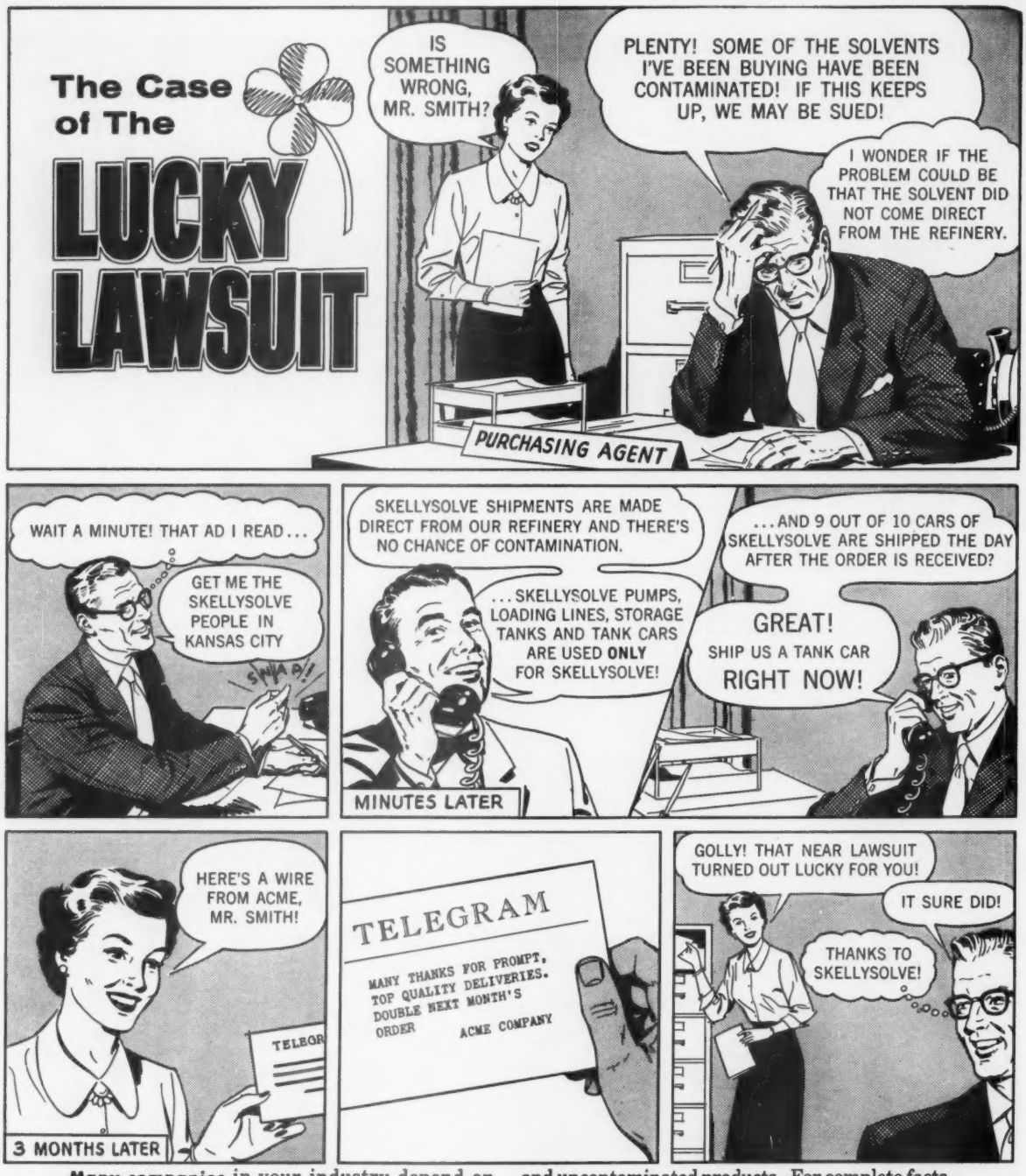
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• All nine German tire factories have increased their prices. Price increases have also been announced by branch factories of foreign manufacturers, such as Michelin and Goodyear, and representatives of foreign manufacturers, such as the Italian Pirelli. German factories state that they have been forced to increase prices because quotations for natural rubber have been raised in the last few months.

Tire prices have been increased by 2 to 5 per cent. The smallest increase of 2.5 per cent applies to one of the most popular tire sizes, the 5.60-15 used for the Volkswagen. Forty per cent of the German market consists of this size. Truck tires have been raised by 5 per cent because they require the largest percentage of natural rubber. At present, Volkswagen tires cost approximately $12.90 each.

Following the German tire price increase, France has raised her prices by 8 to 10 per cent. Notwithstanding the latest increase, prices for truck tires are still cheaper than they are in West Germany. Passenger car tires are about equal as far as prices in France and Germany are concerned. However, selling prices for French truck tires are about 25 to 50 per cent lower than German tires, particularly in the territory of the Saar.

Prices have also been increased in The Netherlands. Here, the increase amounted to 3 per cent and it is believed that tire importers in Holland will follow suit. This is the third country in the European Common Market to raise tire prices Although all three are justified because of the price increases in the natural rubber market, it is interesting to note that the three countries have tried to establish a similar price level so that henceforth, when adjusting their decreasing import duties, they will all more or less have the same price basis.

• All German tire factories have, with the consent of the government, established a cartel whereby not only selling prices for all types of tires for cars, trucks, agricultural machinery and industrial uses have been established, but also various discounts. Depending upon the purchases, a bonus discount between 3 per cent, applicable to sales up to approximately $2,500, and 8½ per cent, for orders mounting to $150,000, will be granted.

In addition to these discounts, regular trade discounts from 15 to 17 per cent will be used. A bonus discount will be granted at the end of the year, based upon purchases made during the preceding 12 months. Imported tires, such as those from Pirelli and Yokohama, will not be included in the purchases, which apply only to products of factories manufacturing in Germany. The French branch factory, Michelin, and American Goodyear are included, however.

• Describing the development of the chemical industry in the Soviet Union, a communist author writes in *Plaste und Kautschuk:* By 1950 chemical production in the Soviet Union increased 15 fold compared with 1928. From 1940 to 1958 total industrial production in the Soviet Union increased 3.4 times. Production in the chemical industry increased 5.9 times during the same period. Today, Russian chemical output stands in first place on the European market. In the world market, Russian output ranks second, with United States capacity in first place. After having fulfilled the goals of the five year plan in 1965, Soviet Russia will match the productive volume of the United States.

• Transparent rubber articles can be produced, according to a patent granted to the Farbenfabriken Bayer, A. G., by making these articles directly from natural rubber latex and incorporating a small proportion of a nitrosamine, preferably diphenyl nitrosamine, in a latex composition containing vulcanizing ingredients.

• The Industrial Development Corp. of the government of South Africa, has succeeded in organizing a corporation with a nominal capital of about $7,000 for the construction of a factory to produce synthetic rubber. The new company, the Synthetic Rubber Development Co. of South Africa, Ltd., has its headquarters in Johannesburg. At present, South Africa requires approximately 20,000 tons of synthetic rubber. The new factory, which will be built by the corporation, will cost approximately $2 million and will have an annual capacity of 20,000 tons. In the years following production start-up, the capacity of the new establishment will be increased.

• The first tire factory in Taiwan, Formosa, has gone on stream. The Nangkang tire factory, organized by Formosa authorities and the Yokohama tire factory in Japan, has turned out 4,000 tires during the first few months of production.

On the Continent (cont'd)

• Japan plans to protect its synthetic rubber production and has conducted discussions with representatives of the rubber and petrochemical industries concerning the possible levy of import duties on synthetic rubber. A representative of the Japanese Ministry of Commerce has declared that a special duty will be necessary to protect the Japanese synthetic rubber industry. At the present time, there is no duty on imported synthetic rubber. However, on raw materials used in synthetic rubber production, such as styrene and butadiene, a duty of 20 per cent is collected.

• The application of flock to rubber and plastic articles is covered in an English patent. Articles of irregular shape, such as gloves, which are made of rubber or plastic are provided with a flock surface by coating the articles with an adhesive, placing them in a chamber and then forming a cloud of flock in the chamber. The cloud of flock is produced by introducing air into the chamber which has previously passed through a container in which flock is maintained in a state of agitation.

The articles to be coated are carried on a conveyor which is operated intermittently to allow the articles to dwell in the flocking chamber. An even coating of flock is applied to the surface of the articles and there is no appreciable waste of flock, as the flock which is not retained by the articles is recovered by drawing it into a duct connected to the floor of the chamber.

• The West German rubber industry reports that 1959 has been a very good year. Production in all areas of this industry has been raised 12 per cent during the last year and some corporations have gone beyond this rate of growth. Employment has risen only by 8 per cent, but this has been caused primarily by extended automation in some factories, and more efficient production methods. In addition, it should be pointed out that it was rather difficult to hire new workers because all over Germany, there is a real dearth of available labor.

• Montecatini Societa Generale per L'Industria Mineralia e Chimica has been granted a patent which uses graft polymers as dispersing agents in the polymerization of vinyl monomers in aqueous suspension. Examples of suitable graft polymers are vinyl chloride-polyvinyl alcohol and styrene-polyacrylic acid.

• Sweden has increased its tire production. Swedish Goodyear Gummi Fabriks Aktiebolag plans to expand its tire production at Noorkoeping because the Swedish market is growing fast, and present facilities will not be able to meet increasing demand. About $2.5 million will be used to install new machinery and equipment for expansion of the existing factory. The work will be finished before the end of this year.

• A Glasgow engineering firm has obtained a contract to supply machinery and equipment for a projected synthetic rubber plant in Siberia. After prolonged negotiations in Moscow, a contract valued at about $300,000 has been granted to the Glasgow engineering firm.

• A patent recently granted to an English company states that natural rubber latex can be vulcanized in latex form by exposing it to a radiation dosage between 1 and 60 megarads, and preferably between 10 and 40 megarads.

• The Soviet Union has given assistance to several foreign countries in the construction of chemical facilities, according to a report in the East German publication, *Plaste und Kautschuk*. The reports says: In addition to the tremendous task of building her own chemical industry, Russia gives technical and financial aid to other countries in the construction of chemical plants. In accordance with a mutual economic assistance pact, Soviet experts have completed plans for a pipe-line to transport Russian crude oil from oil wells in the Volga to the western part of the Soviet Union and from there to Poland and the German Democratic Republic. An additional line will move the oil to Hungary and the Czechoslovakian Republic.

In 1959, plans were completed for a number of chemical projects in the Democratic Republic of China, the Roumanian Peoples Republic and the Democratic Republic of Vietnam. In India and Iraq, chemical plants based on Soviet Union plans, will be built with the assistance of Russian experts. Egypt is expected to receive complete installations from Russia within the next five years and Argentina has received a credit amounting to $100 million from Russia for the purchase of equipment and machinery for her crude oil industry.

• The head of the Indonesian Foreign Economic Relations Directorate has stated that an agreement signed recently in Moscow calls for the delivery of 20,000 tons of rubber from Indonesia to the Soviet Union in 1960.

• Israel will buy natural rubber directly from Asia and Africa in order to increase the volume of trade between Israel and Africa and Asia and to provide cargo for Israeli shipping lines operating in Ceylon, the Belgian Congo and Liberia.

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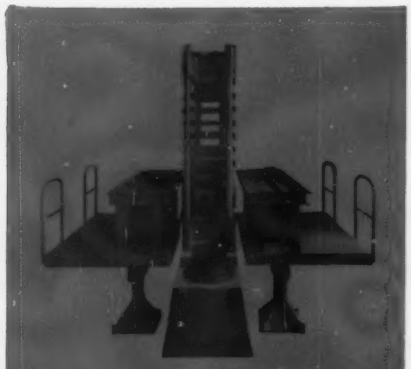

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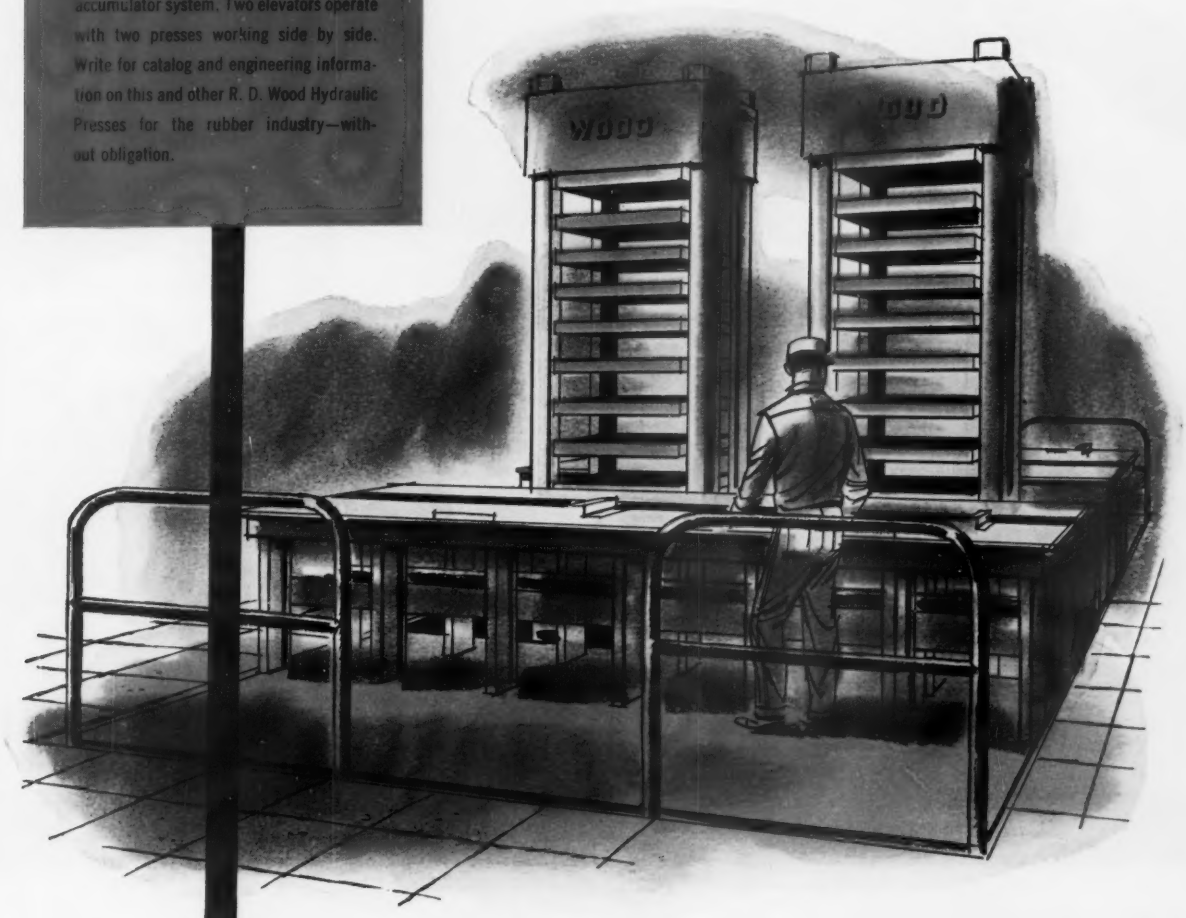

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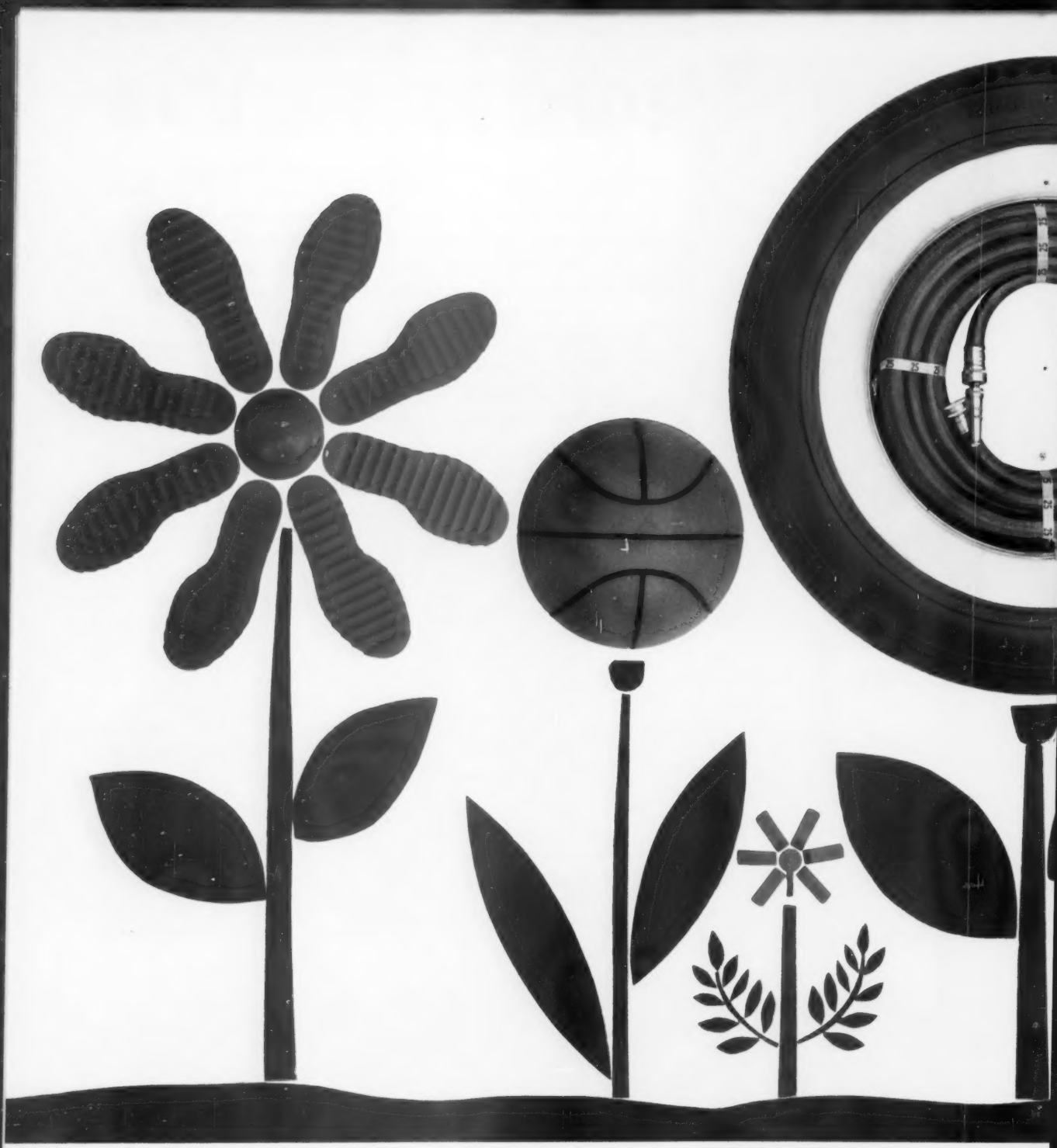

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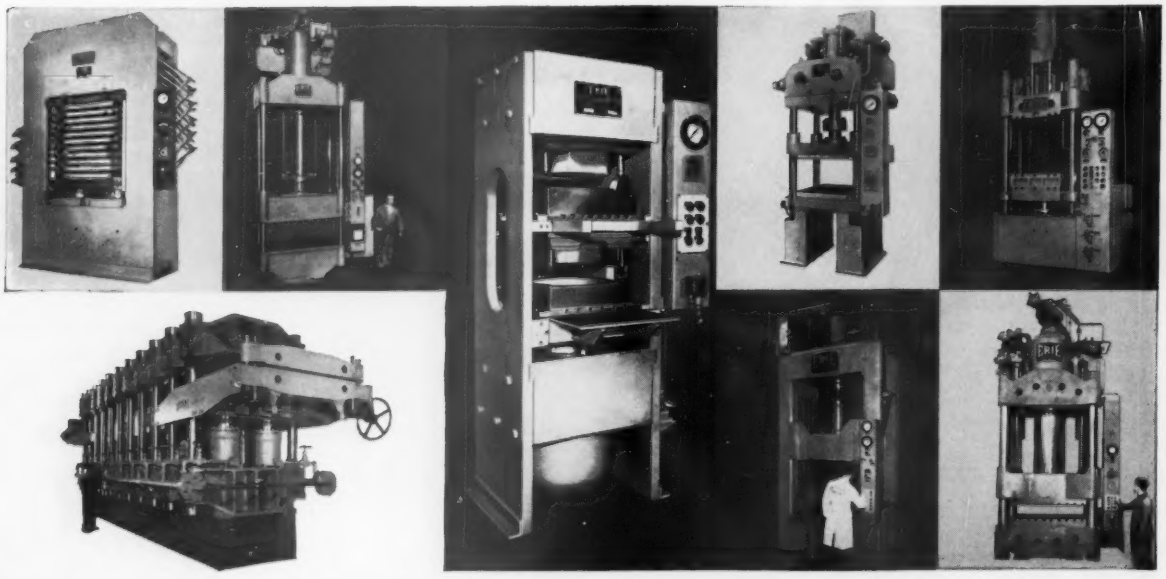

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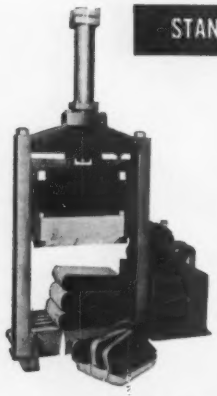

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New Delhi—Dayton Rubber Co. and Premier Tyre Ltd., a new Indian firm, have completed plans for a $4 million tire and tube factory in Cochin, Keral State. To start production in 1961, annual capacity of the facility will be 250,000 tires and tubes.

Buenos Aires—Texas Butadiene Co., Houston, Texas, has concluded negotiations for a $39,000,000 investment in a synthetic rubber and carbon black plant in Argentinian Patagonia. The plant will be in Puerto Deseado and will utilize natural gas resources from state oil fields in Santa Ruz Province.

Sucre—Bolivian Oil Co. is reportedly planning construction of a $3 million carbon black facility which will utilize locally produced gas. To have a capacity of 8,000 tons annually, the project is up for approval by the state petroleum agency.

New Delhi—A new $28.4 million synthetic rubber plant will be constructed at Bareilly in Utter Pradesh by the Firestone Tire and Rubber Co. and Indian Industrialists. Firestone is investing $15.75 million in the new venture. Initial capacity of the plant will be 20,000 tons per year, but later, it is expected to be expanded to 30,000 tons annually.

Rio de Janeiro—Artefato de Borracha Andino Ltda. has started construction of a factory in the industrial city of Belo Horizonte. The plant will manufacture rubber products for the automotive and aeronautical industries.

New Delhi—Alkali and Chemical Corp. of India, a subsidiary of Imperial Chemical Industries, plans a $4.2 million organic chemicals plant at Rishra. The plant will have an annual capacity of 32,000 tons and will produce a range of industrial organic chemicals including accelerators, antioxidants, retarders and other rubber chemicals. Construction of the unit is expected to make India self-sufficient in rubber chemicals and to save that country over $2 million a year in foreign exchange.

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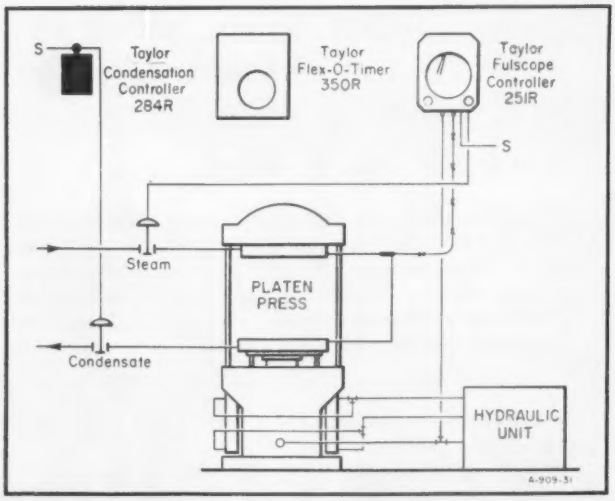

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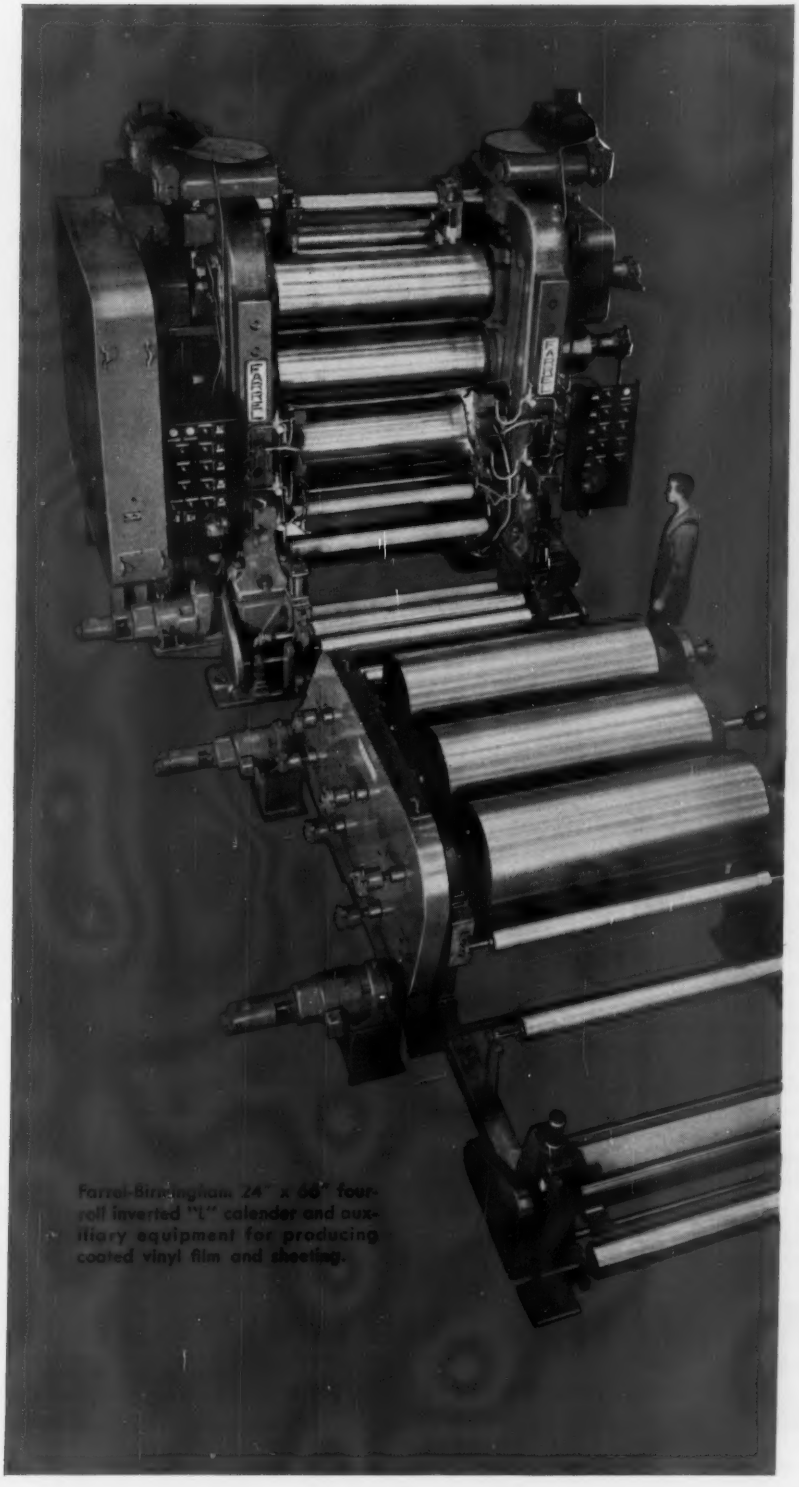

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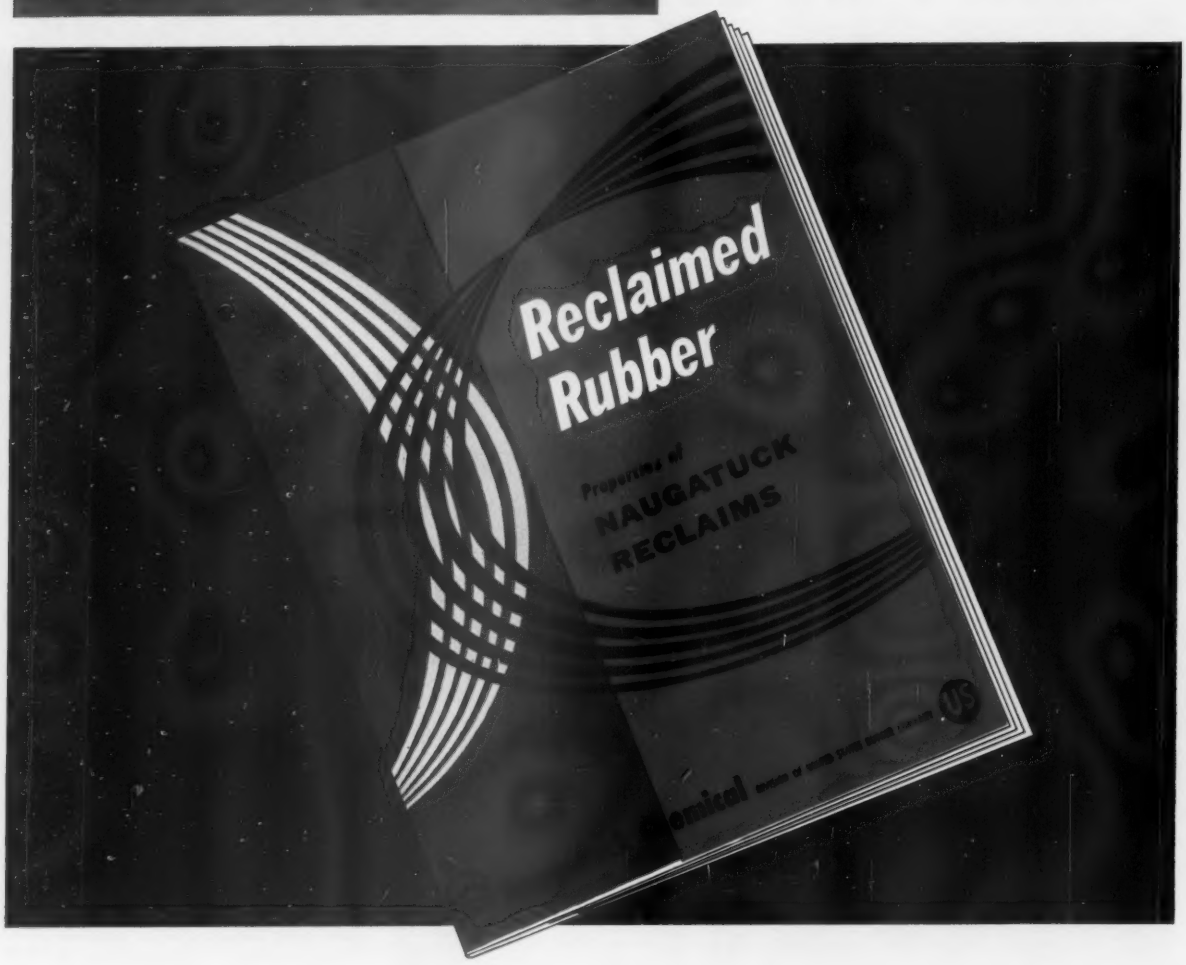

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The Structure of Dispersed Carbon Blacks

By ANDRIES VOET and W. N. WHITTEN Jr.
J. M. Huber Corporation
Borger, Texas

A newly developed electrical approach measures the rate and magnitude of structure formation

IN A PREVIOUS communication *(1)* an analysis was made of the structural involvement of a channel black dispersed in a liquid hydrocarbon matrix by measuring the d-c conductivity and dielectric constant in quiescent and sheared dispersions. This method was based on the observation that structural involvement promotes the formation of conductive particle chains, greatly enlarging conductivity.

The dielectric constant is increased as a result of the formation of anisometric agglomerates. These structures are progressively destroyed by subjecting the dispersions to increasing rates of shear; thus, their resistance to destruction is easily followed. A comparison was also made with rheological data.

The measurements have now been extended to include a series of carbon blacks covering the entire range of rubber reinforcement and color blacks.

Experimental Method

The apparatus used has been described previously *(1)*. In the center of the cylindrical conductivity cell is a rotating electrode. The applied potential differences selected were low enough to ensure the validity of Ohm's Law: generally 50-100 mV/cm. The blacks were carefully dried commercial products, pelletized except for acetylene black. They were incorporated into the vehicle in an 8 per cent by weight dispersion through a stainless steel laboratory ball mill.

All other concentrations were made by dilution. The vehicle was a white mineral oil, liquid petrolatum U.S.P.

Conductivity in Sheared Dispersions

Data were obtained for dispersions of 2, 4 and 8 per cent by weight at 30 and 70°C., subject to shear rates up to 1200 reciprocal seconds. The desired minimum value of the conducticity (K_{min}), the conductivity of the ultimate kinetic units in the absence of particle chains, may be obtained by one of two methods. In the more dilute dispersions, a minimum is generally observed in the conductivity-shear relation which indicates the shear rate where the chains have been broken up completely. At this minimum the decrease in conductivity caused by the destruction of the chains is counteracted by an electron transfer mechanism promoted by a rapidly increasing rate of particle collision due to the higher shear rates *(1)*.

In the more concentrated dispersions, the minimum is not always reached in view of the maximum shear rate permitted by the rotating electrode. In these cases, graphic extrapolation of the conductivity to "infinite" shear was carried out in a diagram in which the conductivity had been plotted against the reciprocal value of the square of the shear rate. The results are given in Table I.

The conductivity data for thermal blacks are too low to be reported with significant accuracy. Any tendency to form structures, however, is completely absent in these blacks. The conductivity of the vehicle is of the order of 10^{-14} mho/cm and the contribution

Note: This paper was presented at the 75th Meeting of the Division of Rubber Chemistry, ACS, in Los Angeles, Calif., May, 1959.

TABLE I—CONDUCTIVITY MINIMA K_{min}

Type of Black	External Surface Area m^2/g	K_{min} in Mho × 10^{12}/cm 2% 30°C.	2% 70°C.	4% 30°C.	4% 70°C.	8% 30°C.	8% 70°C.
SRF	21.3	0.35	1.6	3.6	16	40	193
HMF	32.6	0.50	2.2	5.2	23	60	260
FEF	51.0	0.90	6.6	17.0	102	210	8,000
HAF	77.7	1.30	7.2	18.0	200	220	3,900
ISAF	109.2	2.50	15.0	28.0	300	800	140,000
SAF	130.0	2.20	13.8	30.0	280	2,900	27,000
Acet. Bl.	65.2	13.00	210.0	380.0	160,000	1,650,000	36,000,000
CF	49.3	7.20	50.0	180.0	150,000	780,000	28,000,000
MPC	86.5	0.65	3.8	7.0	31	80	360
Color Bl.	106.1	1.80	10.4	24.0	170	330	4,900
Graphon	90.0	1.60	46.0	16.0	660	180	9,160

of the vehicle to the conductivity is therefore negligible.

Plotting the values for K_{min} for 2 per cent dispersions at 30°C. in a diagram versus the external surface area of the blacks as obtained from electron micrography, the data for most of these blacks fall on a straight line through the origin (Figure 1). A large deviation was found for acetylene black and for the conductive furnace black, while a small deviation was observed for the ISAF black. Only the MPC falls below the line.

The measurement of K_{min} was made under conditions favoring the elimination of particle chains by the application of high rates of shear. In the absence of structural involvement, the contribution of the dispersed phase to the conductivity of the dispersion is expected to be proportional to the exposed external surface area of the particles S_{em} because the black particles themselves are conductors of the electric current while the hydrocarbon vehicle is an insulator. This relationship is verified in Figure 1, from which the following relationship may be derived:

$$K_{min} = C \times S_{em} \quad (1)$$

whereby C is a constant of the value of 1.7×10^{-14} for a 2 per cent dispersion at 30°C., when K is measured in mho's and S_{em} in m^2 per gram.

To include all blacks, the following empirical relationship is valid:

$$K_{min} = I_k \times C \times S_{em} \quad (2)$$

whereby I_k is defined as the conductivity index. It was found that at 30°C. for a 2 per cent dispersion, all indices are equal to 1.00 except acetylene black ($I_k = 11.9$), the conductive furnace black ($I_k = 8.4$) and the ISAF black ($I_k = 1.35$).

To find the conductivity index for 70°C., we must take into account that the conductivity generally increases proportional to the absolute temperature and inversely proportional to the vehicle viscosity. For the vehicle selected, the increase from 30 to 70°C. is calculated as a factor 4.4. Thus, for 2 per cent dispersions at 70°C. the constant C will be 7.5×10^{-14}, and the conductivity index may be calculated accordingly. Similarly, conductivity indices have been derived for 4 and 8 per cent dispersions at 30 and 70° C. (Table II).

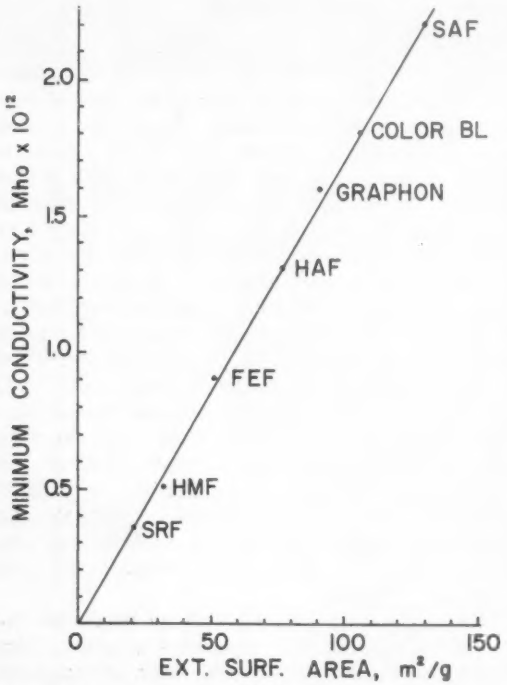

FIG. 1—Relation of minimum conductivity to external surface areas of 2% black dispersions at 30° C.

Limiting Rate of Shear

While the structural index is characteristic of the structural involvement in a given dispersion, the rate of shear required to obtain the minimum conductivity, denoted as the limiting rate of shear (LRS), is indicative of the forces required to break up the particle chains, and thus of the forces acting between the ultimate kinetic units of the dispersion. The higher the LRS, the stronger the units are held together in chains.

Table III shows the limiting rates of shear for 2 per cent dispersions of various carbon blacks. It is to

TABLE II—CONDUCTIVITY INDICES

Black	2% 30°C.	2% 70°C.	4% 30°C.	4% 70°C.	8% 30°C.	8% 70°C.
SRF	1.00	1.00	1.00	1.00	1.00	1.00
HMF	1.00	1.00	1.00	1.00	1.00	1.00
FEF	1.00	1.66	2.00	2.73	2.20	18.90
HAF	1.00	1.25	1.38	3.50	1.51	6.10
ISAF	1.35	1.85	1.54	2.94	3.90	155.00
SAF	1.00	1.43	1.38	2.93	11.90	25.10
Acet. Bl.	11.80	43.30	34.90	3,340.00	16,900.00	66,800.00
CF	8.60	13.60	21.90	4,140.00	8,400.00	68,600.00
MPC	∞1.00	∞1.00	∞1.00	∞1.00	∞1.00	∞1.00
Color Bl.	1.00	1.32	1.36	2.18	1.66	5.58
Graphon	1.00	6.90	1.00	9.98	1.00	12.30

be noted that for acetylene black and conductive furnace black true minima were found in the conductivity-shear rate curves, although the structural index is considerably larger than unity.

Conductivity in Quiescent Dispersions

The change in conductivity with time, after discontinuation of shear, was measured for dispersions of 2, 4 and 8 per cent of black at 30 and 70°C. Typical data are given in Figure 2, where the conductivity of 2 per cent dispersions of ISAF, HAF and FEF blacks at 30°C. are plotted versus the logarithm of time in a semi-logarithmic plot. The curves are all S-shaped, as the result of the existence of a latent period, known as the induction period, during which the conductivity remains of the order of 10^{-12} mho. At the end of the induction period, which was 10, 70, and 100 seconds for ISAF, HAF and FEF, respectively, a rapid rise in conductivity is observed, followed by a progressively slower increase to the final maximum. Even more striking are the semi-logarithmic plots of the change in conductivity dk/dt versus the logarithm of the time, as shown in Figure 3 for 2 per cent dispersions of SRF and FEF at 30°C.

From these data it appears that there are a number of physical properties characteristic of the process of structure formation as observed by conductivity measurements. These include the induction period

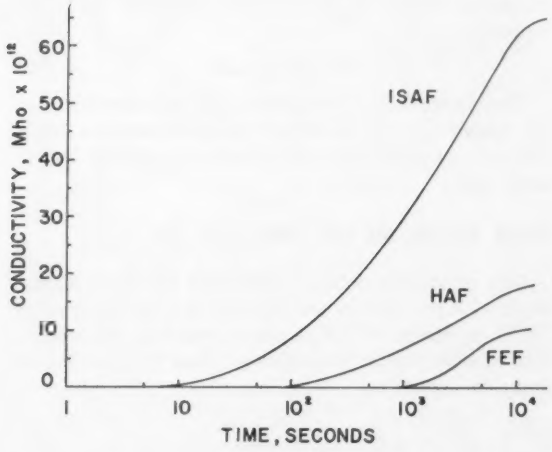

FIG. 2—Semi-logarithmic plot of conductivity for 2% dispersions of three blacks at 30° C. versus time.

TABLE III—LIMITING SHEAR RATES FOR 2% DISPERSION OF CARBON BLACKS IN WHITE MINERAL OIL

Blacks	LRS, 2%, in rec. seconds 30°C.	70°C.
SRF	<50	<50
HMF	<50	<50
FEF	<50	400
HAF	<50	400
ISAF	400	>1000
SAF	<50	300
Acetylene Black	300	>1000
CF	500	>1000
MPC	<50	<50
Color Black	<50	600
Graphon	<50	400

TABLE IV—CONDUCTIVITY CHARACTERISTICS OF 2% DISPERSIONS

Blacks	Induction Period, seconds 30°C.	70°C.	Max. Rate Period, seconds 30°C.	70°C.	Maximum Rate of Cond. Increase Mho/sec. × 10^{12}
SRF	100	10	100	60	32
HMF	60	10	90	50	25
FEF	100	<1	3000	<1	32
HAF	70	<1	110	<1	16.5
ISAF	10	<1	400	<1	440
SAF	100	<1	300	<1	420
Acet. Bl.	<1	<1	<1	<1	>2000
CF	1.5	<1	20	<1	1210
MPC	30	<1	20	<1	0.30
Color Bl.	100	<1	150	<1	0.87
Graphon	2	<1	45	<1	1.10

and the period of time required to attain the maximum rate of conductivity increase, in addition to the values of the conductivity at the maximum rate, and the maximum end value (K_{max}) attained. Table IV indicates these quantities for 2 per cent dispersions.

In more concentrated dispersions, generally no separate induction period is discernible. However, the conductivity-log time curves in a semi-logarithmic plot all have the typical S-shapes observed in Figure 2, and the inflection points correspond to the points of maximum shear rate of the more dilute dispersions. Conductivity equilibrium is often only reached after 24 hours or even longer. The accuracy of the end values is somewhat reduced because slight vibrations may influence the final values. Moreover, in a few instances settling occurs, which generally decreases the conductivity. In these cases the maximum value is not quite the ultimate value desired. Data are given in Table V.

The ratio of maximum to minimum conductivity is a significant indication of the change in structural build-up with changing temperatures and concentrations. The logarithms of this ratio are given in Table VI.

Dielectric Constant

The dielectric constant was measured in dilute quiescent dispersions as well as in chemically deflocculated dilute dispersions *(1)*. Chemical deflocculation with suitable polar deflocculants is experimentally simpler and far more effective than mechanical deflocculation by application of high shear. However, this approach is not satisfactory for conductivity measurements, in view of the marked influence of the deflocculants on the conductivity of the dispersions. Their influence on the dielectric constant, though, is negligible.

Table VII indicates the relative dielectric constants E_rV (ratio of dielectric constants of dispersion to vehicle) in the original dispersions, as well as $(E_r)_\infty$, the relative dielectric constant of the deflocculated dispersions. In addition, form factors f and the products

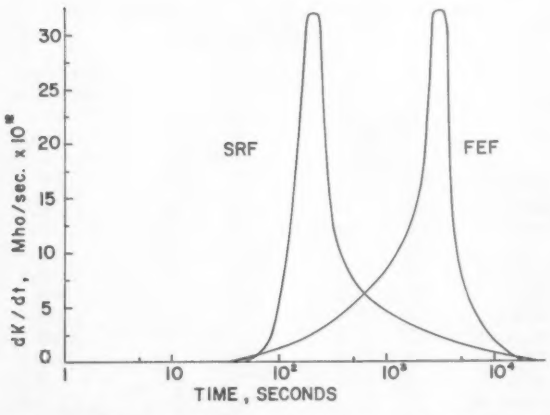

FIG. 3—Semi-logarithmic plots of change in conductivity versus time for 2% dispersions of two blacks at 30° C.

TABLE V—MAXIMUM CONDUCTIVITIES IN MHO × 10^8

Blacks	30°C. 2%	30°C. 4%	30°C. 8%	70°C. 2%	70°C. 4%	70°C. 8%
SRF	0.22*	4.90	50	1.05*	22	210
HMF	0.14*	4.60	60	0.48*	14	114
FEF	10.4	100	230	87	337	470
HAF	18	70	280	51	150	1210
ISAF	65	270	3950	290	2400	10,600
SAF	65	140	205	270	375	1290
Acet. Bl.	3.75	14.1	1000	25.2	320	2500
CF	68.0	900	3600	120	500	9800
MPC	0.035	0.26	1.27	0.19	1.20	5.00
Color Bl.	0.14	0.85	7.0	1.05	5.2	49
Graphon	0.085	0.40	1.7	3.45	22	30

* In view of settling, the end point is too low.

TABLE VI—LOGARITHMS OF K_{max}/K_{min}

Blacks	30°C. 2%	30°C. 4%	30°C. 8%	70°C. 2%	70°C. 4%	70°C. 8%
SRF	3.80*	4.13	4.10	3.82*	4.14	4.04
HMF	3.45*	3.78	3.62	3.34*	3.78	3.64
FEF	5.06	4.74	4.04	5.12	4.52	2.77
HAF	4.94	4.59	4.20	4.85	3.87	3.76
ISAF	5.42	4.98	4.69	5.29	4.90	2.88
SAF	5.47	4.67	2.85	5.29	4.13	2.68
Acet. Bl.	3.46	2.57	0.78	3.08	1.30	0.84
CF	4.97	4.26	1.66	4.38	2.52	0.54
MPC	2.73	2.57	2.20	2.70	2.59	2.14
Color Bl.	2.89	2.55	2.33	3.00	2.49	2.00
Graphon	2.73	2.40	1.98	2.88	2.52	1.76

* In view of settling, the end point is too low.

of form factors and agglomeration factor α are given *(2)*.

Form factors have been calculated from the equation:

$$(E_r)_\infty = 1 + 3fC \qquad (3)$$

whereby C is the concentration by volume. Agglomeration factors α have been calculated from the equation:

$$E_r = 1 + 3\alpha fC \qquad (4)$$

The factor f is characteristic of the anisometry of the kinetic units in the deflocculated dispersions, while the product α f denotes the anisometry of the flocculated units.

Plastic Viscosity and Yield Value

The plastic viscosities η and yield values of dispersions of 8 per cent by weight have been determined at 30°C. by means of a high shear rotational viscometer. The specific plastic viscosities η_{sp} have been calculated from the equation:

$$\eta_{sp} = \frac{\eta - \eta_o}{\eta_o} \qquad (5)$$

whereby η_o is the viscosity of the vehicle. By plotting

TABLE VII—DIELECTRIC DATA FOR 2% DISPERSIONS AT 30° C.

Blacks	$(E_r)_\infty$	f	E_r	f_a
FT	1.058	2.06	1.245	8.70
SRF	1.097	3.44	1.324	11.50
HMF	1.092	3.26	1.282	10.10
FEF	1.133	4.72	1.608	21.50
HAF	1.218	7.73	1.598	20.90
ISAF	1.170	5.89	2.133	40.20
SAF	1.189	6.70	2.207	42.80
Acet. Bl.	1.330	11.70	1.835	29.90
CF	1.228	7.80	2.458	59.80
MPC	1.106	3.76	1.209	7.40
Color Bl.	1.163	5.78	1.255	9.03
Graphon	1.163	5.78	1.300	10.60

the logarithm of the specific plastic viscosity of the dispersion versus the external surface area of the blacks in a semi-logarithmic plot, a linear relationship was found to exist for many of the blacks (Figure 4). Thus, generally, the following equation is valid:

$$\log \eta_{sp} = K_\eta \times S_{em} \qquad (6)$$

whereby K_η is a constant.

Major deviations were found for acetylene black and the conductive furnace black. Smaller deviations appear for the FEF, graphon, ISAF and the color black. The following empirical relationship is valid for all blacks:

$$\log \eta_{sp} = K_\eta \times I_\eta \times S_{em} \qquad (7)$$

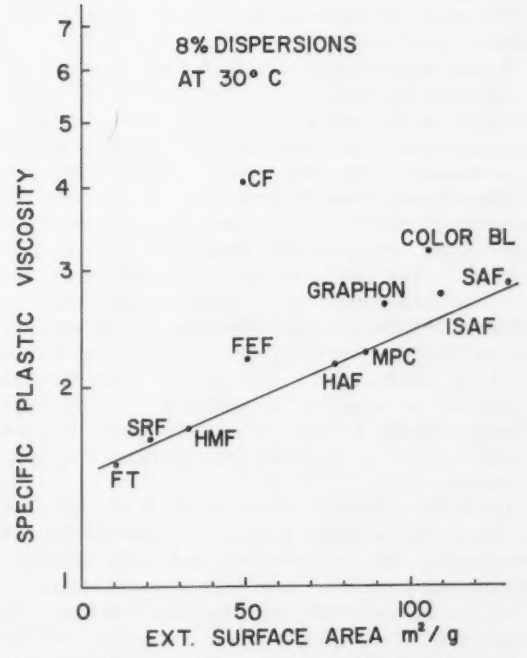

FIG. 4—Semi-logarithmic plot of specific plastic viscosity versus external surface area of 8% dispersions at 30° C.

whereby I_η is the viscosity index. Table VIII indicates specific plastic viscosities, viscosity indices and yield values for 8 per cent dispersions of the various blacks at 30°C. Data for the color black and for graphon are somewhat out of line when compared with structural data obtained from conductivity measurements.

Oil Absorption

Oil absorption data have been obtained with ground pellets of the blacks classified between U. S. standard sieves No. 100 and 200 through a rotap. The oil used was "Polymerik" linseed oil from the Archer-Daniels-Midland Co., Minneapolis, Minn. Figure 5 indicates that when the logarithms of the oil absorption data of the furnace blacks are plotted versus their external surface areas in a semi-logarithmic plot, a linear relation is observed for many blacks. The channel blacks as well as SAF fall somewhat below the line. However, acetylene black and the conductive furnace black are considerably higher than calculated from this relationship. Defining as I_a the oil absorption index, the following relationship appears to be valid:

$$A = K_a I_a \log S_{em} \qquad (8)$$

whereby A is the oil absorption and K_a a constant. The values for I_a are 1.00 for most furnace blacks, slightly lower for the channel blacks and SAF, but 1.85 for acetylene black and 1.54 for the conductive furnace black.

A relation between structure and oil absorption data, though less direct than shown by equation (8), had been indicated by Sweitzer and Goodrich *(3)*. In view of the experimental uncertainties in oil absorption data, which depend on the bulk density of the blacks, oil absorption does not provide more than a qualitative indication of structure.

Densification and Structure

It is known that the process of densification in blacks influences their structure. To obtain quantitative data, samples of an MPC as well as of an SRF

TABLE VIII—RHEOLOGICAL DATA FOR 8% DISPERSIONS AT 30° C.

Blacks	Specific Plastic Viscosity	Viscosity Index	Yield Value dynes/cm²
FT	1.52	1.00	51
SRF	1.68	1.00	40
HMF	1.72	1.00	35
FEF	2.19	1.19	30
HAF	2.13	1.00	92
ISAF	2.77	1.12	70
SAF	2.93	1.00	73
Acet. Bl.	9.22	4.56	143
CF	4.04	2.19	162
MPC	2.21	1.00	59
Color Bl.	3.17	1.20	102
Graphon	2.87	1.17	111

black were examined before and after pelletizing in a commercial unit. The results shown in Table IX indicate the differences in conductivity and viscosity indices. They prove that densification markedly reduces the structure of carbon black dispersions.

In this investigation three different methods of approach to the problem of structure in carbon black dispersions have been followed; namely, conductivity, dielectric constant and rheological properties. Each method emphasizes a different aspect of the complex conception of structure. Conductivity measurements project the process of chain formation, while dielectric data indicate the anisometry of the flocculates. Rheological data are connected with the effective volume and shape of the kinetic units in the dispersion.

The most significant results were obtained by a study of the d-c conductivity of the dispersions. The minimum value of the conductivity, especially the derived conductivity index, is a prime indication of the tendency of the particles to form chains. Table II shows the remarkable position of the high structure blacks, acetylene black and the conductive furnace black, which have a tendency to chain formation under shear far exceeding that of any other black. As may be seen from the table, chain formation is promoted in all blacks by increasing the concentration and the temperature.

Increase of concentration reduces the average distance between the particles, which leads to a greatly increased particle interaction illustrative of the short-range forces acting between the particles. Temperature increase minimizes particle stabilization by reducing vehicle adsorption *(1)*. In addition, reduced vehicle viscosity greatly increases mobility of the particles. Thus, both factors tend to increase the structural involvement of the particles.

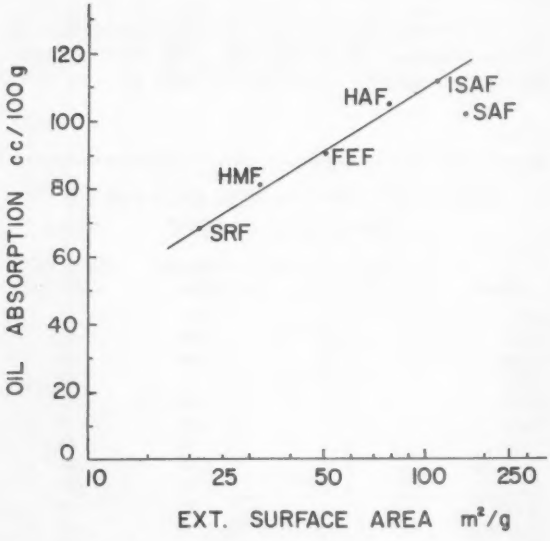

FIG. 5—Oil absorption data versus external surface area of furnace blacks in semi-logarithmic plot.

The limiting rates of shear are indicative of the force required to reduce particle chains to the ultimate kinetic units of the dispersion. However, from the conductivity index it is apparent that the high structure blacks have more complex kinetic units than the other blacks.

It was found that an induction period exists in quiescent dispersions for the conductivity-time relationship. Its magnitude must be considered as an indication of the rate of chain growth. It is evident that the electronic conductance of the electric current through conductive particle chains can only become important when the gaps between growing chains, the spots of extreme electrical resistance, have been significantly reduced in average size. Increasing the temperature greatly reduces the induction period, illustrating the influence of the temperature on chain growth, as indicated in Table IV. Again, the high structure blacks have a very high rate of chain growth, as shown by their rates of conductivity increase. The corresponding values for the channel blacks, for instance, are very much lower.

Conductivity Relationships

The maximum conductivities obtained in quiescent dispersions demonstrate quite clearly the large influence of temperature and concentration on the structure, as shown in Table V. Contrary to the conductivity values in sheared systems however, the high structure blacks are not markedly higher in conductivity than the medium structure blacks. Acetylene black, for example, has a decidedly lower maximum conductivity than the ISAF black. This shows clearly that a true high-structure black requires particles which not only form a structure in dispersion readily, but which materially resist destruction of a once-formed particle chain build-up.

A most interesting quantity is the ratio of maximum to minimum conductivity, indicated in Table VI, which is highest at the lowest temperatures and concentrations, reaching values up to several hundred thousands in some cases. This ratio does not lead to a straight-line conclusion about the structure. In the very low structure blacks this ratio is low, since the structural involvement in quiescent dispersions is not pronounced. The conditions prevailing after the structure has been broken up by shear are not nearly as different from the quiescent dispersions as, for instance, for medium structure furnace black dispersions. Hence the latter blacks have a considerably larger ratio of maximum to minimum conductivity. In the high structure blacks, however, the particle chains are not readily broken up by shear and the ratio, therefore, is smaller again.

Quite characteristic for the blacks is the variation of the ratio of maximum to minimum conductivity with temperature and concentration, indicating again the outstanding properties of the high structure blacks.

Of the dielectric data, the form factor f indicates the anisometry of the kinetic units, since $f = 1.00$ for spherical particles and larger for nonspherical particles. The larger the form factor, the more the

particle deviates from the spherical shape. While it is possible to connect form factors directly with axis ratios in such regular bodies as rotational ellipsoids *(4)*, the most irregular shapes of the carbon black flocculates make such an approach illusory.

The product α f in quiescent dispersions indicates increasing asymmetry of the flocculates. It is noteworthy again, that the acetylene black flocculates are not nearly as anisometric as those of ISAF, SAF and CF.

Rheological data show that specific plastic viscosity is an indication of the extent of structural involvement. However, the data for the color black and for graphon appear to fall out of line. A correlation between structure and yield value, as often suggested in the literature *(5)*, is not apparent. Oil absorption data appear to indicate a structural trend for most furnace blacks, but other blacks do not appear to follow the same relationship.

Classification by Structure

From the foregoing, it is apparent that the various blacks differ markedly in their structural manifestations. We may conveniently divide the investigated blacks into three groups. The outstanding high structure blacks, acetylene black and the conductive furnace black not only show a very pronounced chain formation, but also, in dilute as well as in concentrated dispersions, strongly resist the elimination of structure by shear.

The oil furnace blacks, FEF, HAF, ISAF and SAF, are a group of blacks with medium structure. These blacks show marked chain formation in dilute, and especially, in more concentrated dispersions. However, contrary to the true high structure blacks, upon application of shear these structures are largely destroyed.

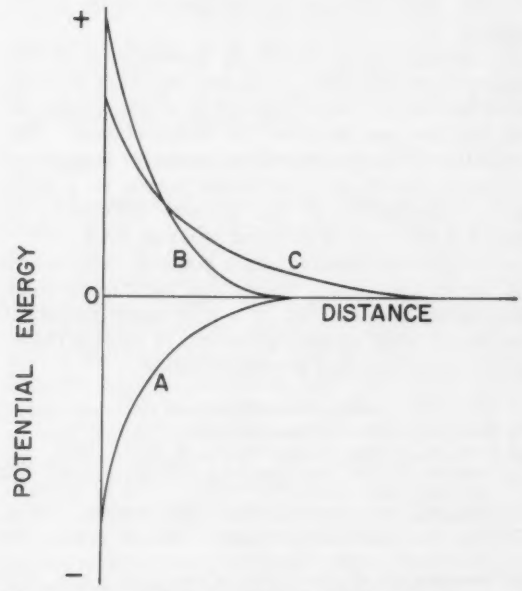

FIG. 6—Typical attraction curve (A) and possible repulsive curves (B, C) of two particles versus their distance.

TABLE IX—CONDUCTIVITY AND VISCOSITY INDICES OF PELLETIZED AND UNPELLETIZED BLACKS

Black	Condition	Density lbs./c. f.	Conductivity Index 8% Dispersion 30°C.	Conductivity Index 8% Dispersion 70°C.	Viscosity Index 30°C.
MPC	Pelletized	23.2	1.00	1.00	1.00
MPC	Unpelletized	11.8	2.58	3.90	1.27
SRF	Pelletized	30.8	1.00	1.00	1.00
SRF	Unpelletized	9.2	1.59	2.19	1.10

Finally, the gas furnace blacks, SRF and HMF, and the thermal black, MPC, and color black form a group of non-structure blacks. The chain formation in these blacks is rather limited, both in dilute and concentrated dispersions. Moreover, whatever structure exists is easily destroyed by the application of comparatively low rates of shear.

Application of Potential Curves

An explanation of the extreme differences in structural behavior between particles of such similar chemical composition and of such comparable size and shape as the various carbon blacks investigated appears to be possible, by considering the differences in particle interaction resulting from differences in characteristics of the particle surface.

Generally, between two carbon black particles a uniform type of attraction exists, as a result of the London-van der Waals forces which are non-specific. Repulsive forces, however, could vary widely, as a result of variation in surface potential, nature of chemical groups on the surface, etc.

Plotting the potential energy of a system of two particles versus their distance in a diagram, potential curves are obtained. Curve "a" of Figure 6 represents a typical attraction curve, such as caused by a London-van der Waals attraction between the particles *(6)*. Curves "b" and "c" represent possible repulsive curves. Curve "b" is of much shorter range than curve "c".

If one of the interaction curves were to overshadow the other completely over the whole range of particle interaction, the net result would be either all-attraction, or all-repulsion. Generally this will not be the case and curves of an intermediate type will result, as exemplified by lines "d", "e" and "f" of Figure 7. It is easy to see that in these cases the preferred particle distance will be the distance of the minimum in the potential energy curves, since the forces acting on the particle at any other distance, as indicated by the tangents of the potential curves, are of opposite sign and thus favor the position of the minimum for the particles. Since the attractive potential curves are similar for different blacks, variation in the repulsive potential curve may result in a change from all-out

attraction via a series of intermediate positions to all-out repulsion.

From these views the phenomena of structure formation are advantageously considered. All-out repulsion of particles is characteristic of systems without any structural build-up. Such systems are approximated by chemically deflocculated non-structure black dispersions, where the adsorbed deflocculant provides the repulsive forces between the particles.

The group of non-structure blacks may represent the type "d" potential curve. There is a rather mild tendency to form structures, but since the equilibrium distance of the particles is rather large and the potential energy trough very shallow, the structures are most easily broken up. It must be remarked that particle separation over small distances, of the order of 1 μ, does not prevent electronic conductance in particle chains, as was shown by Frenkel *(7)*.

The intermediate group of blacks may be represented by curve "e" of Figure 7. Here the equilibrium position of the particles is one of closer approximation. However, the potential energy trough is not very deep and the structure is readily broken up by the application of shear. Finally, high structure blacks may be represented by curve "f". Here the equilibrium is one of close approximation of the particles with a very deep potential energy trough, making it difficult to break up the structure by shear alone.

It is also clear that chemical deflocculation, which increases particle repulsion, may drastically modify the potential energy curves to make energy troughs more shallow and at greater distances. Thus, chemical deflocculation could be extremely effective, as clearly appears from experiments *(1)*.

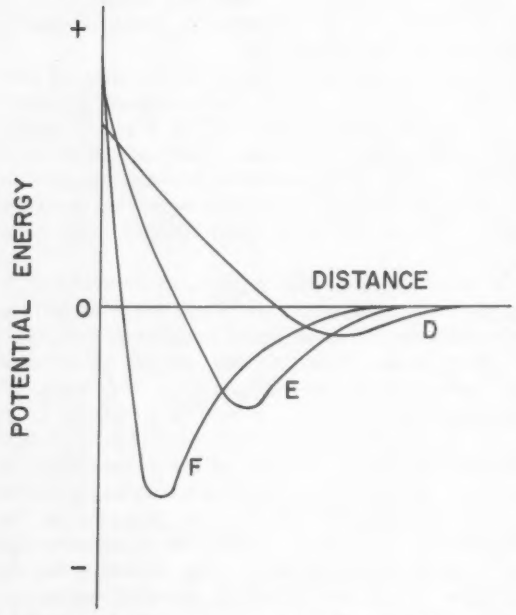

FIG. 7—Potential energy curves for non-structure (D), medium structure (E) and high structure blacks (F).

There is every indication that the basic characteristics of the carbon black particles govern their structure. The influence of the vehicle in the absence of chemical deflocculants is not very significant. This is quite apparent from the very similar structural behavior of the various types of black dispersed in a liquid hydrocarbon or in one of the many types of elastomers available, or even dispersed in a gas. This latter conclusion may be drawn from the ease of recovery of oil furnace blacks from a furnace. The non-structure gas blacks require powerful mechanical and electrical recovery systems. The intermediate structure furnace blacks are much more easily recovered, while the high structure blacks can be completely recovered by very simple mechanical means.

The structural involvement of a carbon black, whether dispersed in gases, liquids or elastomers, is the result of an interplay of attractive and repulsive forces between individual particles. The present investigation employs a recently developed electrical approach, by means of conductivity and dielectric constant measurements, for the study of the structure of carbon blacks dispersed in a white mineral oil at several concentrations and temperatures while subject to varying rates of shear.

Differences in electrical conductivities have been found between quiescent and sheared dispersions varying from none up to nearly six orders of magnitude. Equally, large differences in the rates of conductivity changes resulting from shear rate changes were observed, allowing conclusions about magnitude and rate of structure formation in blacks.

A minimum was found in the conductivity-shear rate relationship for all blacks, indicative of the forces required for mechanical structure elimination. An induction period for reformation of the structure was observed varying from less than one to several hundreds of seconds, dependent upon the type of black. Dielectric data indicated the anisometry of the agglomerates.

It appears that a system of classification of the structural characteristics of carbon blacks is possible on the basis of the degree and rate of structure build-up and the inherent resistance to deflocculation. The application of potential energy curves to analysis of structural phenomena contributes greatly to a more basic understanding of the extreme differences in structural behavior of different types of black.

A correlation appears to exist between the structure and the specific plastic viscosity of the carbon black dispersions, as measured in a high shear rotational viscometer, while oil absorption data of furnace blacks indicate their tendency to agglomeration.

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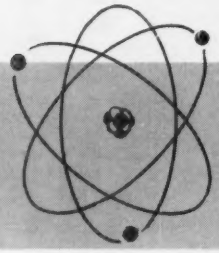
Elastomers for Use in Radiation Fields: Part VI



Radiation Resistance of the Neoprenes

By ROBERT HARRINGTON

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THE PREVIOUS articles in this series have presented background information on the subject of radiation damage to organic polymers, outlined the method of measuring physical properties, presented some sections concerning basic considerations, shown how gamma radiation affects the physical properties of many classes of elastomers and rubber-like plastics, and presented data on the effect compounding ingredients and polymer types have on the radiation resistance of nitrile elastomers *(1-5)*.

This article continues the presentation of data on the effect specific variables have on the radiation resistance of elastomeric polymers. Specifically, this article discusses the radiation resistance of six of the more commonly used neoprene polymers and how they are affected by some compounding ingredients. Due to the many variables involved, the attempt was made not to be all-inclusive, but rather to present the data in the hope that it will provide useful engineering information, as well as contribute to a better understanding of the effect exposure to ionizing radiation has on elastomeric polymers.

Experimental Procedure and Results

All materials were exposed to gamma radiation and evaluated by recording changes in physical properties, as described previously *(1)*. For all irradiations up to and including 1×10^5 r, a 1.3×10^6 r/hr Cobalt-60 source at Hanford was used. In order to reduce the exposure time for the higher doses, a 5×10^6 r/hr Cobalt-60 source at Hanford was substituted. Property changes resulting from irradiation of the same materials to a given total dose from the two sources agreed closely enough so that it can be assumed the experimental results obtained are independent of source of radiation.

The recipes and cure schedules for the neoprene elastomers studied here are listed in Table I. Other neoprene compounds included here for discussion purposes have been described previously *(3)*.

The data obtained from exposing the listed neoprene elastomers to various doses of gamma radiation in air at 25°C. at normal atmospheric pressure, and at 25°C. in vacuo are presented in Table II. This table shows original property values on the line for zero irradiation dose, followed by per cent property changes resulting from various gamma radiation exposures. The original color of each material is given on the same line in the remarks column; significant color changes and other observations are listed below, opposite the particular radiation dose causing the phenomena. Table III gives the results obtained from the irradiation of stressed neoprene compounds.

Alteration of Physical Properties

The data presented in Table II and in a previous article *(3)* show that all neoprene materials become hard and brittle, and exhibit great increases in tensile strength on prolonged exposure to ionizing radiation. At low and intermediate doses, the tensile strength trend varies considerably, which is attributed to the various compounding ingredients. The elongation of the materials decreases while the hardness increases with increasing exposure. Because tensile strength behavior appears to be more dependent upon the compounding ingredients, the discussions to follow will be more concerned with it than with hardness, elongation or flexibility (brittleness). Comments on these properties will be made only when definite trends are noted and whenever specific points deserve mention.

Compounds A109D-97 through A109D-102 represent gum stocks of the six types of neoprene—W, WHV, WRT, GN, GN-A and GRT—which are in common use today. All of these materials were cured with minimum amounts of zinc oxide and magnesia, in order to have the purest possible vulcanized gum rubber. Thus the effects of radiation on the basic neoprene types could be studied with minimum interference or masking from other compounding ingredients. It was necessary to include a small amount of accelerator in types W, WHV and WRT, but a proper cure of

TABLE I—RECIPES OF NEOPRENE ELASTOMERS USED FOR GAMMA IRRADIATION STUDIES

Recipe Materials	Neoprene Compound A109D— 87	88	89	90	91	92	97	98	99	100	101	102
Neoprene Type GN	100.0	—	—	—	—	—	—	—	—	100.0	—	—
Neoprene Type GN-A	—	100.0	—	—	—	—	—	—	—	—	100.0	—
Neoprene Type GRT	—	—	100.0	—	—	—	—	—	—	—	—	100.0
Neoprene Type W	—	—	—	100.0	—	—	100.00	—	—	—	—	—
Neoprene Type WHV	—	—	—	—	100.0	—	—	100.00	—	—	—	—
Neoprene Type WRT	—	—	—	—	—	100.0	—	—	100.00	—	—	—
Stearic Acid	0.5	0.5	0.5	0.5	0.5	0.5	—	—	—	—	—	—
Neozone A	2.0	2.0	2.0	2.0	2.0	2.0	—	—	—	—	—	—
Zinc Oxide	5.0	5.0	5.0	5.0	5.0	5.0	1.00	1.00	1.00	1.0	1.0	1.0
Magnesia	4.0	4.0	4.0	4.0	4.0	4.0	1.00	1.00	1.00	1.0	1.0	1.0
FEF Black	3.0	3.0	3.0	3.0	3.0	3.0	—	—	—	—	—	—
NA-22	—	—	—	0.5	0.5	0.5	0.25	0.25	0.25	—	—	—

	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	135	136
Neoprene Type GN	100.0	100.0	100.0	—	100.00	—	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Neoprene Type W	—	—	—	100.00	—	100.00	—	—	—	—	—	—	—	—	—	—	—
Stearic Acid	0.5	0.5	—	—	—	—	—	—	0.5	0.5	0.5	—	—	0.5	0.5	—	—
Zinc Oxide	5.0	5.0	1.0	5.00	5.00	5.00	1.0	1.0	1.0	5.0	5.0	1.0	1.0	5.0	5.0	1.0	1.0
Neozone A	4.0	6.0	4.0	—	—	—	4.0	4.0	4.0	2.0	2.0	4.0	4.0	2.0	2.0	4.0	4.0
Magnesia	4.0	4.0	1.0	4.00	4.00	4.00	1.0	1.0	1.0	4.0	4.0	1.0	1.0	4.0	4.0	1.0	1.0
FEF Black	3.0	3.0	—	—	—	—	3.0	3.0	—	15.0	30.0	15.0	30.0	50.0	100.0	50.0	100.0
Kenflex A	—	—	—	—	—	—	—	5.0	—	—	—	—	—	—	—	—	—
Octamine	—	—	—	8.00	4.00	4.00	—	—	—	—	—	—	—	—	—	—	—
Aranox	—	—	—	2.00	1.00	1.00	—	—	—	—	—	—	—	—	—	—	—
Atomite Whiting	—	—	—	50.00	50.00	50.00	—	—	—	—	—	—	—	—	—	—	—
SRF Black	—	—	—	15.00	15.00	15.00	—	—	—	—	—	—	—	—	—	—	—
NA-22	—	—	—	0.75	0.75	0.75	—	—	—	—	—	—	—	—	—	—	—
Indonex 637 1/2	—	—	—	10.00	10.00	10.00	—	—	—	—	—	—	—	—	—	—	—
Thiuram E	—	—	—	—	—	0.25	—	—	—	—	—	—	—	—	—	—	—
Sulfur	—	—	—	—	—	0.60	—	—	—	—	—	—	—	—	—	—	—

All compounds furnished by du Pont Elastomer Chemicals Dept. and cured 20 minutes at 307° F.

the other three types could be effected without it, because the W types are more stable in gum form than the G types. The difference in cures obtainable is, therefore, a function of the manner in which gum rubbers are manufactured and made available for processing into cured or vulcanized compounds. Hence it is assumed that radiation effects on these materials best reflect differences in the type of neoprene available from the manufacturer.

The data from Table II show that all six of the neoprenes exhibit the same general trend in property changes. Figure 1 graphically illustrates how radiation affects gumstocks from type GN and WRT neoprene. Hardness is increased with increasing radiation exposure, the softer materials becoming harder at a greater rate. Elongation decreases with increasing exposure for all of the materials. The tensile strength is lowered at the low and intermediate exposures, before being considerably increased at the higher doses. All materials were relatively brittle, breaking when subjected to the bend test after an exposure of 1×10^8 r.

At the highest exposure examined, 3×10^8 r, all the W types lost 100 per cent of their original elongation, while the G types retained a small percentage. Although the G types failed the bend test, they were slightly more flexible than the W types which also failed the test. It is interesting to note that the W types increased more in tensile strength in terms of both percentage and actual change. In some instances the materials with the lowest original tensile strength increased at greater rates, as was generally true for hardness.

Effects on Prototype Compounds

Compounds A109D-87 through A109D-92 were also prepared to determine how radiation affects the six types of neoprene. The recipes contained an antioxidant, lubricant, greater amounts of curing agents and a small amount of carbon black loading. Compounds A109D-90, 91 and 92, representing neoprene types W, WHV and WRT, respectively, contained a small amount of accelerator for equivalent cure purposes. The six materials in this series could be considered practical compounds because of potential end-applications, but they do not contain sufficient amounts of compounding ingredients to completely mask the effects of radiation on the basic neoprene polymer.

In this series of compounds, the superior radiation resistance of the G types (Compounds A109D-87, 88 and 89, representing neoprene types GN, GN-A and GRT, respectively) is more readily seen, particularly with respect to flexibility. The G types did not fail the bend test until exposed to a dose of 3×10^8 r, while the W types failed the same test after an exposure of 1×10^8 r.

According to their flexibility and retention of properties, these neoprenes are ranked in the following order of decreasing radiation resistance: GN, GN-A, GRT, W, WHV and WRT. It is interesting to note that the G series containing carbon black and

TABLE II—EFFECT OF GAMMA RADIATION ON THE PROPERTIES OF NEOPRENE ELASTOMERS

Materials	Dose ($r \times 10^{-6}$)	Initial Properties and Percent Change: Hardness Shore A; Δ %	Elongation %; Δ %	Tensile psi; Δ%	Remarks
A109D—87	0	53	920	4000	Black
	5	3.8	— 8.7	— 1.9	
	10	5.7	—28.0	—36.5	
	50	26.4	—82.6	—82.8	
	100	47.2	—92.9	—81.0	
	300	88.7	—97.8	— 4.6	a
A109D—88	0	53	900	4170	Black
	5	3.8	—12.8	—11.3	
	10	5.7	—27.6	—33.7	
	50	26.4	—82.2	—84.2	
	100	43.4	—91.7	—83.6	
	300	88.7	—98.3	1.4	a
A109D—89	0	53	900	4100	Black
	5	3.8	—12.2	—11.3	
	10	5.7	—25.6	—33.3	
	50	26.4	—82.2	—84.1	
	55 V	26.4	—81.1	—81.1	b
	100	45.3	—91.7	—82.3	
	300	88.7	—97.8	74.4	a
	300 V	88.7	—98.9	93.5	a, b
A109D—90	0	51	770	3025	Black
	5	3.9	—11.7	— 6.5	
	10	3.9	—27.3	—36.7	
	50	33.3	—84.4	—82.6	
	100	56.9	—94.2	—78.8	a
	300	96.1	—98.7	38.7	a
A109D—91	0	52	680	2470	Black
	5	3.9	—10.1	— 1.6	
	10	5.8	—22.3	—18.6	
	50	30.8	—83.9	—74.7	
	100	55.8	—95.6	—79.3	a
	300	92.3	—99.3	172.5	a
A109D—92	0	49	755	2235	Black
	5	4.1	—13.8	— 9.0	
	10	6.1	—25.7	—27.3	
	50	38.8	—84.7	—79.2	
	100	67.4	—94.7	—76.1	a
	300	104.1	-100.0	152.0	a
A109D—97	0	71*	920	2400	Dark Cream
	5	7.0	—57.6	—57.3	
	22	15.5	—91.8	—82.5	c
	55	21.1	—96.7	—81.5	c
	100	26.8	—97.8	—77.6	a, d
	300	40.6	-100.0	139.9	a, e
A109D—98	0	70*	615	1630	Mottled Cream-Tan
	5	7.1	—52.8	—47.5	
	22	22.9	—88.6	—75.3	c
	55	26.2	—94.3	—76.3	c
	100	29.3	—96.7	—70.3	a, d
	300	42.9	-100.0	217.9	a, e
A109D—99	0	42	950	2200	Cream
	5	11.9	— 52.1	—67.9	
	22	50.0	—89.5	—87.5	c
	55	78.6	—95.8	—85.9	c
	100	100.0	—97.4	—75.0	a, d
	300	138.1	-100.0	190.1	a, e
A109D—100	0	50	890	3800	Brown
	5	4.0	—25.8	—15.0	
	22	20.0	—78.1	—92.0	c
	55	44.0	—93.3	—90.9	c
	100	66.0	—95.5	—84.3	a, c
	300	100.0	—97.6	10.3	a, f
A109D—101	0	50	920	3175	Brown
	5	1.0	— 9.8	—11.8	
	22	14.0	—60.9	—81.3	c
	55	32.0	—89.1	—88.1	c
	100	56.0	—93.5	—84.3	a, c
	300	100.0	—97.3	17.6	a, f
A109D—102	0	48	940	3600	Brown
	5	2.1	—13.8	—16.7	
	22	18.8	—70.2	—87.2	c
	55	45.8	—92.6	—90.5	c
	100	70.8	—95.2	—84.7	a, c
	300	108.3	—98.4	20.6	a, f
A109D—119	0	50	940	3900	Black
	5	2.0	—11.0	—10.6	
	22	12.0	—51.1	—70.4	
	55	28.0	—80.3	—83.7	
	100	38.0	—89.4	—83.1	
	300	100.0	—98.9	30.3	a
A109D—120	0	49	920	3500	Black
	5	2.0	— 3.2	0.0	
	22	12.2	—48.9	—47.5	
	55	24.5	—76.1	—79.4	
	100	38.8	—87.0	—81.1	
	300	104.1	—96.7	29.2	a
A109D—121	0	44	960	3000	Dark Brown
	5	0.0	— 6.1	0.0	
	22	11.4	—47.9	—70.3	c
	55	25.0	—83.9	—90.5	c
	100	43.2	—87.5	—87.0	c
	300	118.2	—93.6	—18.2	a, f
A109D—122	0	58	660	2015	Black
	5	0.0	— 7.6	— 9.7	
	22	9.4	—39.4	—39.8	
	55	22.4	—69.7	—51.8	
	100	37.9	—83.3	—48.3	
	300	69.0	—95.5	63.4	a
A109D—123	0	61	710	2075	Black
	5	1.6	— 1.4	0.0	
	22	9.8	—39.4	—32.6	
	55	23.0	—71.8	—45.5	
	100	34.4	—83.1	—44.0	
	300	63.9	—97.2	84.4	a
A109D—124	0	59	840	2305	Black
	5	1.8	— 4.8	— 3.8	
	22	12.5	—29.8	—18.6	
	55	28.6	—66.7	—48.4	
	100	41.1	—86.3	—56.3	
	300	78.6	—97.6	40.7	a
A109D—125	0	45	980	3800	Black
	5	4.4	—10.2	—23.0	
	22	13.3	—41.8	—64.9	
	55	24.4	—83.7	—91.5	
	100	40.0	—86.7	—87.4	
	300	113.3	—94.9	—38.0	a
A109D—126	0	43	1080	3600	Black
	5	4 7	— 9.3	—30.6	
	22	14.0	—46.3	—57.5	
	55	23.3	—81.5	—90.0	
	100	39.5	—86.1	—87.6	
	300	116.3	—94.9	—47.5	a

TABLE II—EFFECT OF GAMMA RADIATION ON NEOPRENE ELASTOMERS (Cont.)

Materials	Dose ($r \times 10^{-6}$)	Initial Properties and Percent Change: Hardness Shore A; Δ %	Elongation %; Δ %	Tensile psi; Δ%	Remarks
A109D—127	0	43	960	3200	Dark Brown
	5	4.7	— 6.7	—40.6	
	22	11.6	—44.8	—76.1	
	55	23.3	—84.4	—92.2	
	100	39.5	—87.5	—89.9	
	300	118.6	—94.8	—38.0	a
A109D—128	0	60	830	3580	Black
	5	1.7	— 9.6	— 1.4	
	22	8.3	—47.0	—32.5	
	22 V	10.0	—50.6	—34.3	b
	55	20.0	—73.5	—65.5	
	100	33.3	—86.7	—49.7	
	300	65.0	—96.4	2.5	a
A109D—129	0	71	575	3275	Black
	5	1.4	—16.5	— 6.7	
	22	7.0	—44.3	—11.5	
	22 V	8.5	—46.1	—10.2	b
	55	14.1	—73.9	—31.8	
	100	22.5	—86.1	—28.7	
	300	40.8	—98.3	52.7	a
A109D—130	0	56	960	3520	Black
	5	0.0	—12.5	— 1.3	
	22	8.9	—47.4	—33.7	
	22 V	8.9	—45.3	—24.2	b
	55	21.4	—76.6	—60.0	
	100	32.1	—86.5	—66.1	
	300	66.1	—93.8	—29.7	a
A109D—131	0	66	730	3110	Black
	5	1.5	—16.4	— 5.0	
	22	9.1	—54.1	— 8.4	
	22 V	7.6	—47.9	— 4.7	b
A109D—131 (Cont.)	55	16.7	—72.6	—20.4	
	100	24.2	—83.6	—26.0	
	300	47.0	—94.5	13.7	a
A109D—132	0	82	280	2700	Black
	5	1.2	—10.7	— 2.6	
	22	3.7	—35.7	— 9.3	
	55	8.5	—66.1	—14.6	
	100	12.2	—82.1	—14.3	
	300	22.0	—98.2	56.9	a
A109D—133	0	97	100	2395	Black
	5	0.0	0.0	3.2	
	22	0.0	—30.0	10.9	
	55	0.0	—70.0	11.3	a
	100	1.0	—90.0	20.5	a
	300	3.1	-100.0	102.9	a
A109D—135	0	80	385	3100	Black
	5	1.3	—11.7	— 1.6	
	22	6.3	—40.3	— 0.8	
	55	10.0	—66.2	— 3.1	
	100	13.8	—81.8	— 2.4	
	300	22.5	—94.8	28.2	a
A109D—136	0	97	105	2570	Black
	5	0.0	— 4.8	— 2.8	
	22	1.0	—33.3	— 3.3	
	55	2.1	—71.4	3.4	a
	100	2.1	—85.7	28.4	a
	300	3.1	-100.0	44.9	a
A411A—1313	0	64	635	2120	Black, g
	55 V	26.2	—80.0	—69.0	b
	300 V	56.3	—98.4	118.6	a, b

* Material was crystallized during cold weather transit, thus giving abnormally high hardness values.
Remarks: a = broke when bent 180 degrees, b = irradiated in vacuo, c = darkened, d = dark brown, e = almost black, f = black, g = see reference *(3)* for more data.

other ingredients was better in radiation resistance than its gum stock counterpart, while resistance of the two W type series was essentially the same. On the basis of percent change in properties, the W types of gum stocks were lowered considerably in tensile strength and elongation by an exposure of 5 x 10^6 r, while their counterparts in the other series dropped only slightly. The G type neoprenes in both series behaved quite similarly on a percent change in properties basis.

The degree of superiority of G over W types, while quite pronounced in stocks containing a relatively small amount of compounding ingredients, is not apparent in the more complex compounds which contain more types or amounts. For example, a comparison of compounds A109D-123 and A411A-1313 *(3)*, which are heat resistant stocks from types GN and W, respectively, containing a variety of compounding materials (including an accelerator for type GN) shows that the compounds have about equal resistance to radiation after an exposure of 3 x 10^8 r. In this case the tensile strength of the GN material increases more at the 3 x 10^8 r exposure than the W material. This is the reverse of what happened to the tensile strength of type GN and W compounds in the first two series.

Mechanism of Radiation Damage

From the data presented in Table II, it is difficult to state precisely the nature of the mechanisms damaging the neoprenes as a result of exposure to ionizing radiation. It appears, however, that at the highest doses the materials become increasingly cross-linked, forming a highly three-dimensional network in the polymer which renders the material stiff, hard and brittle, and increases its tensile strength. At low and intermediate exposures, other factors and mechanisms appear to compete with the net effect of reducing the tensile strength considerably. This finding is based upon results obtained with materials in the first two series—simple compounds which probably do not contain sufficient amounts of compounding ingredients

to mask the effects occurring in the basic polymer. The following discussions of carbon black loading show that parallel trends in tensile strength are somewhat different, although the mechanisms may very well be the same.

It is well known that the neoprenes can be damaged by exposure to various forms of oxygen, such as heat aging in air and ozonation of stressed specimens. Severe oxidation (e.g., oxygen bomb aging) tends to chain cleave the polymer while moderate oxidation (e.g., heat aging in air at 70°C.) tends to cross-link it *(6)*. On the other hand, severe ozonation of stressed specimens causes cracks in the material perpendicular to the applied stress, and, if the conditions are sufficiently severe, the specimens will actually break *(6)*.

Since radiation can induce oxidation in many organic polymers which are irradiated in air, several neoprenes were irradiated in both air and vacuum to determine the extent that oxygen plays in radiation damage. Compounds A109D-87, 119 and 120 represent the same type GN compound and contain two, four and six parts antioxidant, respectively, for protection against possible radiation-induced oxidation. The data from Table II show that up to an exposure of 3 x 10^8 r there is very little difference in the radiation resistance of these three materials. The latter two materials increase more in tensile strength at high exposure; in other respects the materials are affected in essentially the same way.

Compound A109D-121 contained four parts of an antioxidant; otherwise, it was the same type of GN gum stock as Compound A109D-100. After an exposure of 3 x 10^8 r, the tensile strength trend was the reverse of the above case in which the materials had several compounding ingredients. The present compound containing antioxidant did not increase its tensile strength on both an actual and percent change basis to the extent the other material did. This compound also retained more of its elongation. The differences in tensile strength behavior of the two series of compounds with varying amount of antioxidant are attributed to the influence of the other compounding ingredients. With result to flexibility, Compound A109D-121 was superior to the others in this test series.

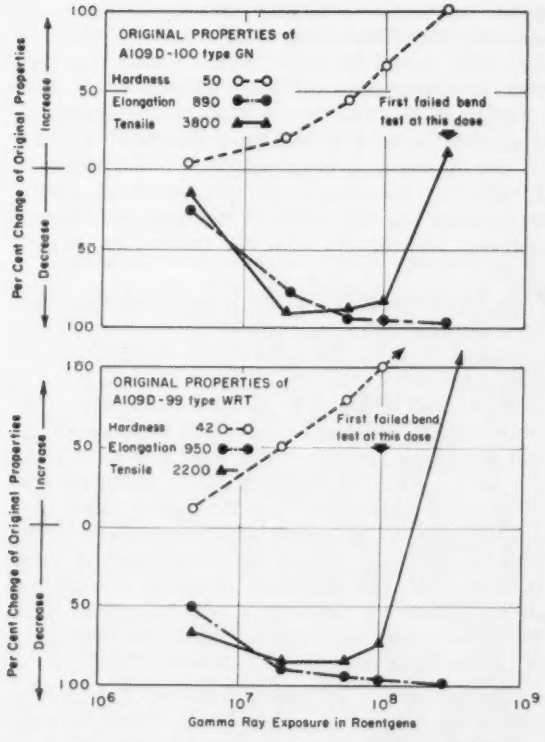

FIG. 1—Comparison of property changes in GN and WRT type neoprenes induced by exposure to gamma radiation.

TABLE III—IRRADIATION OF STRESSED NEOPRENE COMPOUNDS

Compound	Stress (psi)	Strain (%)	Radiation Exposure	Results
A109D—100	85	50	2.2×10^7 r	No cracks
A109D—123	220	60	2.2×10^7 r	No cracks
A109D—100* ...	185	110	1.2×10^8 r	No cracks
A109D—123** ..	475	110	1.2×10^8 r	No cracks

* Tension set of 100 per cent after irradiation.
** Tension set of 80 per cent after irradiation.

Variables Affecting Oxidation

A consideration of data obtained from materials containing none to several parts antioxidant suggests that, at the lower doses, the antioxidant is somewhat effective in retarding losses in tensile strength and elongation, although compound A109D-121 appears to be an anomaly in this instance. At the high exposures, the antioxidant seems fairly effective in retaining elongation and flexibility. Indeed, the best compounds with respect to retention of properties and flexibility were A109D-121, 126 and 130—all containing an antioxidant. This superiority in radiation resistance can, however, be considered a borderline difference of degree rather than kind. Other factors to be taken into consideration with respect to the materials studied include plasticizers and fillers.

An examination of Table II data obtained from Compounds A109D-89, 128, 129, 130 and A411A-1313 *(3)*, irradiated in air and in vacuo to the same total dosages, shows that there is virtually no difference in radiation induced damage. It is, therefore, concluded from this work and that cited above that oxygen per se plays a minor role in radiation induced damage to the neoprenes in specimen thicknesses of approximately .075 inches, under these test conditions.

Ozone formed continuously during the irradiation of air *(1)* offers a potential hazard to neoprenes in stressed condition in a radiation field. To determine the effects of radiation-formed ozone on stressed neoprene materials, Compound A109D-100 gum stock without an antioxidant, and Compound A109D-123

heat-resistant stock fortified with an antioxidant, were irradiated in stressed conditions to 2.2 x 10^7 r and 1.2 x 10^8 r. The conditions and results of these irraditions, given in Table III, show that none of the materials were stress-cracked. It is therefore, concluded that, under these conditions of irradiation and stress, ozone is not a factor to be considered in applying neoprenes for use in radiation fields. Although not completely resistant to radiation-induced stress cracking, they can be considered satisfactory for most applications.

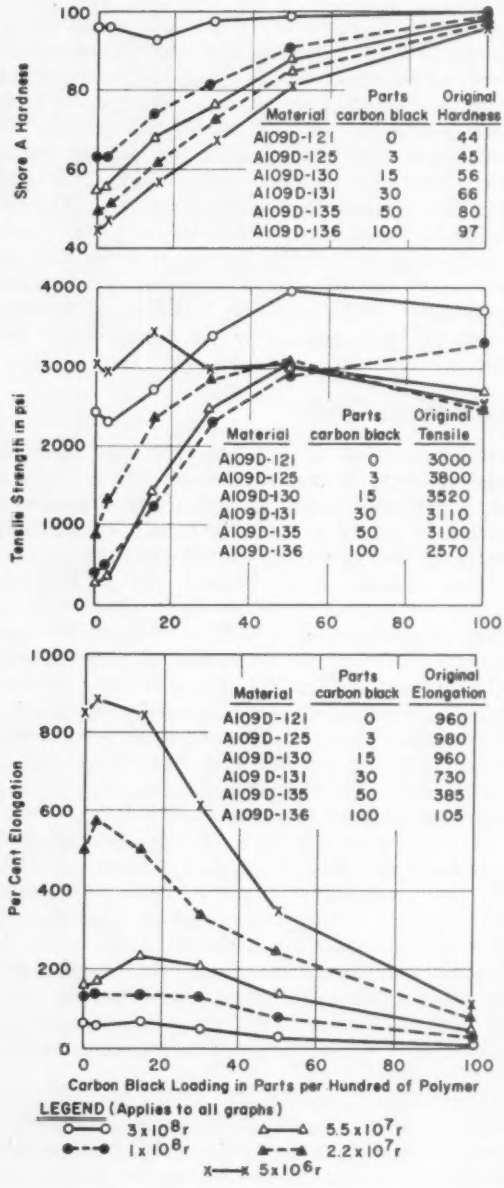
Shore A Hardness
Material | Parts carbon black | Original Hardness
A109D-121 | 0 | 44
A109D-125 | 3 | 45
A109D-130 | 15 | 56
A109D-131 | 30 | 66
A109D-135 | 50 | 80
A109D-136 | 100 | 97
Tensile Strength in psi
Material | Parts carbon black | Original Tensile
A109D-121 | 0 | 3000
A109D-125 | 3 | 3800
A109D-130 | 15 | 3520
A109D-131 | 30 | 3110
A109D-135 | 50 | 3100
A109D-136 | 100 | 2570
Per Cent Elongation
Material | Parts carbon black | Original Elongation
A109D-121 | 0 | 960
A109D-125 | 3 | 980
A109D-130 | 15 | 960
A109D-131 | 30 | 730
A109D-135 | 50 | 385
A109D-136 | 100 | 105
Carbon Black Loading in Parts per Hundred of Polymer
LEGEND (Applies to all graphs)
3x10^8r
1x10^8r
5.5x10^7r
2.2x10^7r
5x10^6r

FIG. 2—Effect of carbon black on the radiation-induced changes in physical properties of a type GN neoprene elastomer.

Adding Carbon Black

To study the effect of carbon black on the radiation-induced changes in the neoprenes, a FEF (fast extruding furnace) carbon black was selected as being representative of a typical carbon black filler. Based upon work with styrene rubbers *(7)*, other types of carbon black, would probably affect the neoprenes in slightly different ways, but it is believed the differences would be of degree rather than kind. From zero to 100 parts loading of carbon black per 100 parts polymer were studied using neoprene type GN. Two series of compounds were used. The first contained curing agents, antioxidant, lubricant and varying amounts of carbon black. The second contained minimum curing agents, an antioxidant and varying amounts of carbon black.

Results of the work using the second series are shown in Figures 2 and 3. The former shows actual property changes, while the latter shows percent change in properties. Other neoprene compounds, containing carbon black and mentioned here for discussion purposes, have been described in a previous article *(3)*. These materials behaved in essentially the same manner as those being considered here. In instances where different types of fillers were used, the effects on the property changes were also quite similar.

The property which is most noticeably affected by variations in carbon black loading is tensile strength. On the basis of actual tensile strength values, no definite trend can be noted. At each radiation exposure, the various values of tensile strength for each material appear to be dependent upon the original value. At one dose, for example, the material with 30 parts carbon black would have the highest tensile strength, while at another dose a different material would have a higher value. On the basis of percent change in properties, there is a definite trend illustrated in Figure 3. For the material with no carbon black, Compound A109D-121, the tensile strength decreases rapidly until dosage reaches approximately 1 x 10^8 r, then it increases considerably but not beyond its original value.

As the carbon black loading is increased, the tensile strength reductions are progressively retarded up to a loading of 50 parts. Here the tensile strength is essentially unaffected until an exposure of 1 x 10^8 r is reached, after which it is raised considerably. The same trend is noted in the 100-part material, except that the tensile strength climbs after a dose of about 5 x 10^7 r. Also, on a percent change basis, the final value of the tensile strength at the highest exposure of 3 x 10^8 r rises as the carbon black content is increased, with the exception of zero and 3 parts carbon black. In these cases, the final value of tensile strength was slightly greater for the material with no carbon black. The above comments are applicable to the other series of carbon black materials not shown in Figure 3.

The hardness of the materials appears to be a function of the amount of carbon black, except for compounds in both series containing 15 parts at an exposure of 3 x 10^8 r. At this dose the materials were

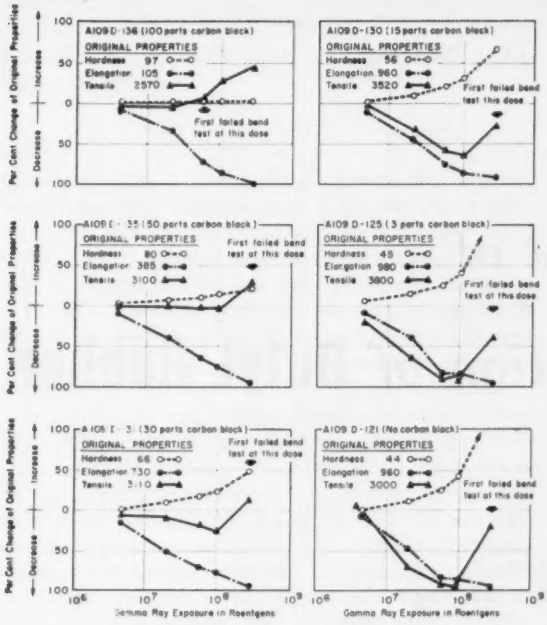

FIG. 3—Effect of carbon black on gamma radiation-induced changes in the physical properties of neoprene elastomer.

somewhat softer than those containing 5 parts. With this exception, the harder materials remained harder during irradiation, with the softer materials showing a greater increase on a percent change basis. The actual hardness of the materials approached the same value as exposures were increased, which is in agreement with work previously reported on silicone and nitrile elastomers *(2, 5)*.

Elongation and Flexibility

No definite trend could be noted with respect to actual changes occurring in elongation. At the low exposures, the 5 part material had the greatest value, the zero and 15 part compounds nearly as much. The remaining materials had values decreasing in the order of increasing carbon black content. At higher exposures, the 15 part material appeared to be superior, but zero, 5 and 30 part materials were about the same. Values for remaining materials were lower in order of increasing carbon black content. On a percent change basis, all materials were affected in essentially the same manner, except the compound with 100 parts which lost all of its elongation at the highest exposure.

Flexibility of the materials appears to be a function of the carbon black loading only when more than 30 parts have been incorporated. The materials containing from zero to 15 parts were essentially the same, with the zero and 15 part materials possessing a very slight superiority. These flexibility ratings are based on results obtained after 3 x 10^8 r exposures.

Due to the many compounding ingredients and variables involved, comprehensive statements concerning the effect of other compounding ingredients cannot be made. However, it is possible to note a few trends as a result of this work. For example, a comparison between type W materials A109D-97 and A109D-75 *(3)* shows that the latter containing a substantial amount of curing agents was embrittled much sooner. Again, on the basis of flexibility, the material A109D-126, which contained 5 parts of an aromatic plasticizer, was slightly superior to its counterpart, A109D-125, which had no plasticizer. With respect to the processing aid, stearic acid, Compound A109D-121 appeared to be slightly more flexible than A109D-127 which contained less acid.

Major Changes in Summary

The work reported here has indicated how radiation affects the physical properties of six commonly used types of neoprene polymers, and how some compounding ingredients contribute to these changes. In general, tensile strength is the property most sensitive in reflecting the changes caused by different amounts and types of compounding ingredients. Fillers, in particular, regulate the behavior of tensile strength. Flexibility is also a relatively sensitive property for reflecting changes in neoprenes after irradiation. Oxygen apparently plays a minor role in radiation-induced damage to neoprenes. An analysis of the data shows that frequently certain effects caused by materials are masked out by effects of others. Overall changes are roughly a sum of individual net effects. The discussion here has been general in nature and the reader is urged to examine the data in further detail for points not covered.

ACKNOWLEDGMENT

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Acknowledgement is also given to F. M. Newby, Hanford Atomic Products Operation, General Electric Company, for his assistance and cooperation in carrying out the irradiations.

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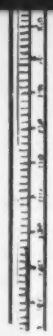

Temperature Coefficient of Vulcanization of Butyl Rubber

Simple laboratory methods show how changes in vulcanization temperature affect rates of cure

By J. G. MARTIN and R. F. NEU

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THE PURPOSE of this study was to determine the temperature coefficient of vulcanization of butyl rubbers with different unsaturation levels and of butyl compounds employing different accelerator systems. Two different techniques were used to determine state of cure, elastic modulus measurements and measurements of equilibrium volume swell.

The temperature coefficient of vulcanization of an elastomer is that factor by which the curing time must be multiplied (or divided) for a 10° F. decrease (or increase) in curing temperature, in order to obtain at the new temperature a state of cure equivalent to that at the former temperature. The coefficient is a measure of the temperature dependence of the rate determining reaction of vulcanization, and, for a given compound, is considered to be a constant within the limits of experimental error. Values for several commercial elastomers have been determined and reported by other workers *(6, 9, 11-14)*. These coefficients generally fall within the range 1.39-1.67 for a 10° F. change.

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Theoretical Background

The temperature coefficient should not be confused with the reaction rate of vulcanization. It is rather a measure of the influence of a change in temperature upon the reaction rate. The accepted method of determining TC is to plot the logarithm of the time required to produce a given state of cure versus the reciprocal of the corresponding temperature converted to the absolute scale. This method yields a straight line from which time values may be interpolated at 10-degree temperature increments. Dividing any given time value by the time value of the 10-degree higher temperature gives the coefficient for the compound. Several calculations should be made to average out the coefficient's slight change with temperature. Figure 1 is exemplary of the plot and calculation.

Thus, for this butyl compound the cure time must be multiplied by 1.35 for a 10° F. drop in press temperature. This value is within the 3-5 per cent testing error in comparison with 1.37, the average TC value. For temperature increments other than 10° F., there is the general relationship:

$$t_2 = TC^{(-0.1\Delta T)} \times t_1 \qquad (7),$$

and $$t_2 = t_1 \times 1.37^{-0.1\Delta T} \quad \text{for butyl.}$$

It is also customary to speak of a time ratio factor, R.F., such that:

$$R.F. = \frac{t_2}{t_1} = 1.37^{-0.1\ (T_2 - T_1)}$$

This R.F. factor is useful for correcting the time for any temperature differential *(9)*. In the above relations, t_1 is the original time, t_2 is the equivalent time, and T_1 and T_2 are the corresponding temperatures.

It is worthwhile to note that TC is not the slope of the line (which is related to the heat of activation [H_a] of the reaction), but a simple ratio of equivalent times obtained at a defined temperature difference of 10° F.

Formerly, in considering time-temperature curing relationships, the rubber industry applied a simple rule of thumb: doubling the cure time of butyl rubber for a temperature drop of 20° F. in order to reach a state of equivalent cure based on recommendations for the higher temperature. This simple time correction is in keeping with the old empirical relation that many reactions at not excessively high temperatures approximately double or treble their velocity for a 10° C. rise in temperature *(4)*. The time-temperature relationship is set forth theoretically in the Arrhenius rate equation $k = Se^{-\Delta H_a/RT}$

in which k is the reaction rate, S is a collision frequency factor, H_a is the heat of activation, R is the gas constant, and T is the absolute temperature. According to the logarithmic statement of this equation,

$$\log k = \frac{-\Delta H_a}{2.303\ RT} + \log S,$$

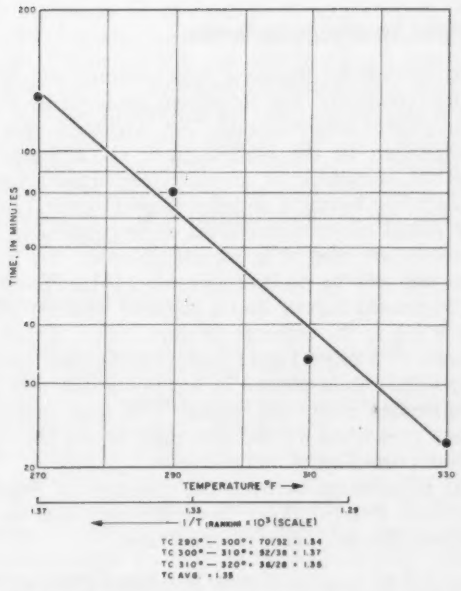

FIG. 1—Determination of TC values for Compound No. 203.

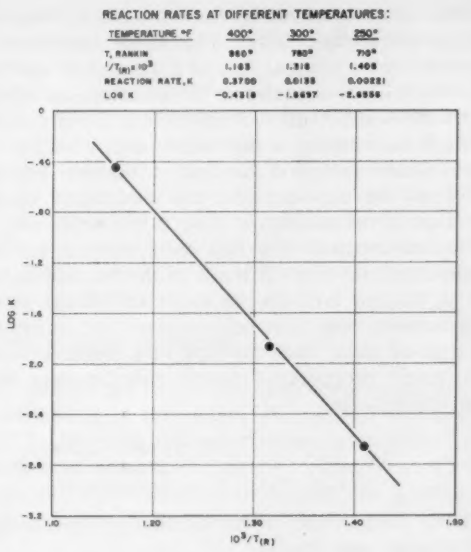
REACTION RATES AT DIFFERENT TEMPERATURES:
TEMPERATURE °F 400° 300° 250°
T, RANKIN 860° 760° 710°
1/T(R) × 10³ 1.163 1.316 1.408
REACTION RATE, K 0.3700 0.0135 0.00221
LOG K −0.4318 −1.8697 −2.6556
LOG K
10³/T(R)

FIG. 2—Arrhenius plot of vulcanization rate versus 1/temp.

in which S is considered constant over a fairly wide range of temperatures. A straight line having a slope of

$$\frac{-\Delta H_a}{2.3\ R}$$

is obtained by plotting log k against 1/T.

Physical Reaction Models

The relationship between the two graphs (Figures 1 and 2) and their equations is as follows:

One hypothesis *(8)* states that the rate determining reaction in vulcanization is the initial scission of the S_8 sulfur ring to give the S_8 chain free radical. In accelerated vulcanization, the rate of this reaction is enhanced by the attack of the accelerator (a free radical) upon the sulfur ring,

$$Z^{\bullet} + S_{8\ (ring)} \qquad Z\text{-}S\text{-}S\text{-}S\text{-}S\text{-}S\text{-}S\text{-}S\text{-}S^{\bullet}$$

but this ring scission, although now a bimolecular reaction, is still the rate determiner. The $Z\text{-}S_{8\ (chain)}^{\bullet}$ free radical is rapidly decomposed via the formation of sulfur cross-linkages with the polymer, and the accelerator free radical is regenerated to attack a second sulfur ring. Therefore, the rate determining bimolecular reaction is of the first order and dependent only on the free sulfur concentration. Gordon's plots of the disappearance of free sulfur *(8)* indicate a kinetic proof that the reaction is of the first order. This point is still somewhat controversial. Two recent papers have taken opposing views as to whether the reaction is truly first order *(3 and 5)*.

Departure from first order characteristics is noted in the later stages. This may be caused either by the loss of accelerator in side reactions, by incipient reversion, or by the increasing importance of butyl's

low level of unsaturation as the cross-linkages use up the reactive olefinic sites. The latter viewpoint is supported by the original data of Zapp and co-workers *(17)*, which Gordon analyzed. Nevertheless, the initiation of this second order characteristic appears in his graphs in the vicinity of maximum cure, which is the region where reversion tendencies become critical. Therefore, one may consider the industrially significant stage of the reaction to have a first order rate.

The rate constant of a first order reaction has the dimensions time^{-1}; i.e., in terms of the fraction or per cent of reactant used up per unit time. If the extent of the reaction were to be held constant, as "an equivalent state of cure," then the time of a reaction would be inversely proportional to the rate constant at a given temperature:

$$t = \frac{a}{k}$$

[a = Proportionality constant for a given state of cure.]

Selecting the half life of the reaction as the constant state of cure, one obtains:

$$t_{1/2} = \frac{0.693}{k}$$

[A defined relation for first order reactions.]

Gordon has calculated the reaction rate constant at three temperatures for each of two accelerator systems in butyl rubber, from which the half-life times and the temperature coefficients can be derived (Table I).

Thus, for the range 400° → 300° F., the average value of the temperature coefficient calculated from a chemical kinetic analysis is 1.37, the same value claimed in this study of physical stress-strain data. The second value for TDEDC is only 5 per cent higher than the average of the higher temperature determinations, but the second value for TMTDS is 20 per cent higher. However, Gordon states that the agreement of his 250°F. rate constants by a factor of 2.2 is good for a kinetic determination. Considering the closer agreement of the other three calculated coefficients and the fact that the good scorch safety claimed for TMTDS may well account for the low reaction rate at 250° F., the high value of 1.72 can be excluded from practical consideration. In fact, this point serves to illustrate the precaution which should be taken to avoid attempts to use the coefficient at temperatures below those necessary to "activate" the accelerator.

TABLE I—DETERMINATION OF TC FROM KINETIC RATE CONSTANT DATA

Accelerators Used	TDEDC			TMTDS		
Temperatures, °F.	400°	300°	250°	400°	300°	250°
Unimolecular Rate Constants, k	0.3700	0.0135	0.00221	0.3000	0.0150	0.0010
Half Life, $t_{1/2} = \frac{0.693}{k}$	1.87	51.3	313	2.31	46.2	693
Temperature Range, $T_1 \rightarrow T_2$	400°→300°		300°→250°	400°→300°		300°→250°
Temperature Increment, ΔT	−100°		−50°	−100°		−50°
Time Ratio Factor, $RF = \frac{t_2}{t_1}$	27.4	6.13	6.13	20		15
Temperature Coefficient: $(TC = RF^{\left(\frac{-10}{t}\right)})$	1.39		1.44	1.35		1.72

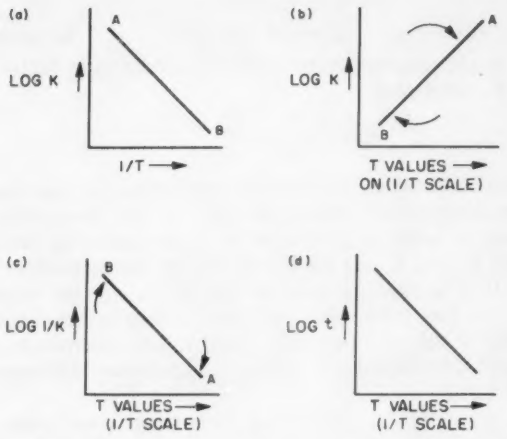

FIG. 3—Relationship between rate constant and temperature coefficient.

Determining Temperature Coefficients

The relationship between rate constant and temperature coefficient can be shown quite easily in a simple graphic interpretation. An Arrhenius plot of the logarithm of the reaction rate (k, a fraction) versus the reciprocal of absolute temperature yields a straight line having a negative slope (Figure 3 [a]). If the actual temperature values corresponding to the reciprocals are plotted in increasing order, the slope of the line will be positive (Figure 3 [b]). The line may be rotated further into a negative slope by plotting log 1/k as the ordinate (Figure 3 [c]). This corresponds to a plot (Figure 3 [d]) of log time versus temperature values plotted in increasing order on the corresponding reciprocal scale. This final graph is the one prescribed for the determination of the temperature coefficient of vulcanization.

The relationship between the ordinates of Figures 3 (c) and 3 (d) follows from the equation stated previously for first order reaction rates:

$$t = \frac{a}{k}$$

[where a = Proportionality constant for a given state of cure.]

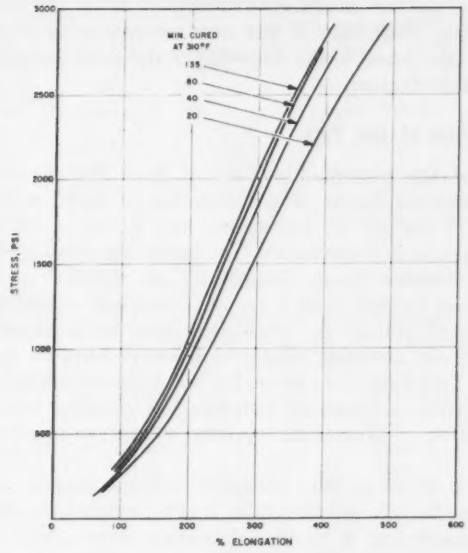

FIG. 4—Stress-strain data for Compound No. 203.

If, when calculating temperature coefficients, the 10° F. increments are taken from the reciprocal scale, TC will decrease with increasing temperature. This implies that TC is not a constant. However, the variation is slight (3 per cent) over the range studied, and the average value may be taken as constant within experimental error.

Earlier workers *(6 and 11-13)* have shown that for natural rubber the temperature coefficient varies from accelerator to accelerator over a range of 32 per cent, actually encompassing the range of accepted coefficients for the important synthetics. It was originally planned to "map out" the temperature coefficients for the usual accelerators in butyl rubber. The low level of unsaturation in butyl rubber, 0.6-2.3 mole per cent (based on 100 per cent in natural rubber), suggested a second factor which needed to be studied. Zapp *(16)* has shown that the more unsaturated grade of butyl has the higher reaction rate and our plots have upheld this reactivity progression. It needed to be shown further whether the rate of change with temperature was also dependent upon the number of possible cross-links.

Test Materials and Methods

Throughout this study, a heat interacted masterbatch containing 50 phr MPC black, 5 phr zinc oxide and 1.2 phr N-methyl, N-nitroso, p-nitroso aniline (Monsanto "Elastopar") was used.

Four grades of butyl rubber varying in unsaturation from less than 1 to approximately 2 mol per cent were examined in a single cure system, and 15 different cure systems (sulfur and quinoid type) were studied in a single grade of butyl. At least three different cure times were used at each of four curing temperatures between 270 and 330° F. In certain cases, higher temperatures (350-400° F.) were used in view of the present trend toward short, high-temperature vulcanization.

Previous investigations used a variety of experimental methods to determine temperature coefficients, including ultimate elongation *(1)*, scorch rate *(14)*, combined sulfur *(2, 11, 12, 13)*, modification of modulus measurements *(2, 6, 11-13)*, and the T-50 test *(2)*. In this study, two techniques have been employed: a method based on modulus measurements and a highly reproducible, volume swell method related to the number of cross-links.

Measurement Based on Modulus

The bulk of the testing involved stress-strain measurements made in accordance with ASTM Method D 412-51T. Stress versus strain curves were plotted on rectangular coordinates (Figure 4). They were drawn as the best smooth curve connecting the measured modulus values at multiples of 100 per cent elongation.

Normally, the 300 per cent modulus is considered in determining the state of cure, but in this case several samples had ultimate elongation in the range of 300-400 per cent. For these samples, especially in overcures, the 300 per cent modulus would be influenced greatly by the crystalline structure of the extended polymer. It was therefore decided that the 200 per cent modulus would be more representative of the state of cure.

The next step in this method was to plot constant temperature parameters of the interpolated 200 per cent modulus values versus the logarithm of the time of cure. Much better curves are obtained by plotting the 200 per cent modulus *as interpolated from the stress-strain curve* rather than the original 200 per cent modulus point recorded on the original tensile sheet. Figure 5 shows the good "family" relationship

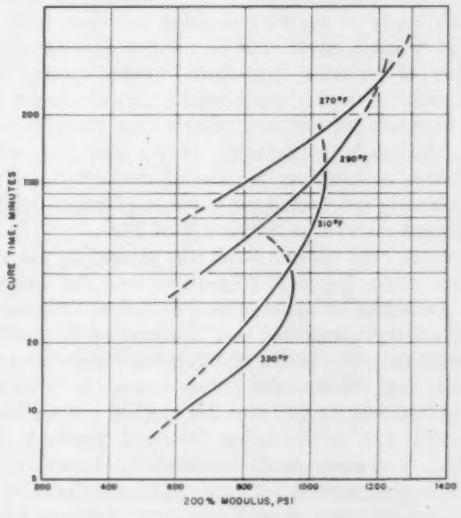

FIG. 5—Cure time versus interpolated modulus of Compound No. 203.

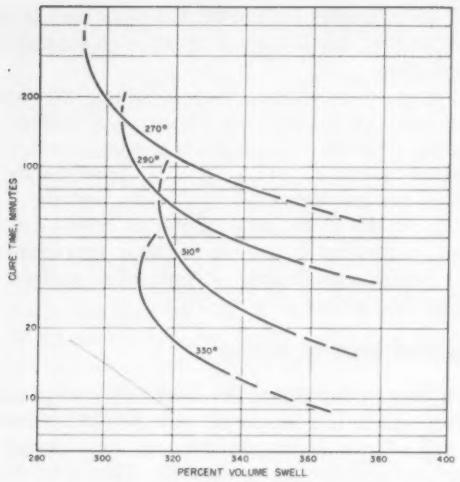

FIG. 6—Compound No. 203 state of cure versus volume swell.

between the temperatures for a given polymer or accelerator.

The temperature coefficient for each stock was then determined by plotting constant modulus parameters of log time versus temperature (Figure 7), and carrying out the calculations shown in Figure 1. The state of cure chosen as constant for one compound did not necessarily have to hold for all. Some compounds with only one accelerator reverted before reaching 900 psi; their coefficients were determined at lower constant cure states. Furthermore, all stocks were checked at lower and higher states of cure, and at 300 per cent modulus if 600-700 per cent elongations were exhibited (as in the case of the least unsaturated grade of butyl used).

The Volume-Swell Approach

This method is the one used by Zapp et al *(17)*, in their study of the vulcanization reaction. The extent of volume swell *(16)* is related directly to the number of chemical cross-links formed during vulcanization. A higher cross-linked sample cannot imbibe as much solvent as a sample at a lower state of cure. Although the presence of the filler does affect the extent of swelling, the use of masterbatches and heat treating for maximum polymer-pigment bonding minimized errors due to the use of filler.

The per cent volume swell was plotted as the state of cure versus log time (Figure 6) and the temperature coefficient was determined as before (Figure 8). Excellent reproducibility was obtained by this method in which the steep slopes of the parameters were more parallel than the modulus curves had been. This may be attributed to the fact that this method is not affected by mold flow or variation in mold pressure, and employs a simpler testing procedure. However, the very close agreement between values obtained by the two methods (less than 3 per cent variation for all except one quinoid cure) and the approximate constancy of the coefficients averaged from the two methods (less than 3 per cent difference in every case) also attest to the reliability of the more common modulus method.

Discussion of Test Data

The data presented in Table II show that the temperature coefficient of vulcanization of butyl rubber is 1.37 for 10° F. increments and 1.76 for 10° C. increments in temperature. In view of the close agreement between values obtained by two different methods and the less than 3 per cent variance among the averaged values, the coefficient may be considered practically constant within the limits of physical testing. This holds true for sulfur and quinoid vulcanization over a range of polymer unsaturation and a variation of accelerator systems, except in a special case.

The effect of filler variation was not studied, but it may be inferred that filler loading would not affect the coefficient if a time correction were made for thermal conductivity *(10)*. Cheyney and Duncan *(1)* have shown that the coefficient of styrene rubber is independent of the type of carbon black used. This suggests a similar independence in butyl.

As is shown in Table II, both CDMDC and ZDMDC have TC values significantly higher than the 1.37 found for the standard accelerators used in butyl rubber. Although LDMDC and BDMDC, two other commercial dithiocarbamic acid salts of transition metals, were not included in this study, it is presumable that they also show high coefficients. Thus, the presence of a transition metal ion (the only differentiating factor between CDMDC or ZDMDC and

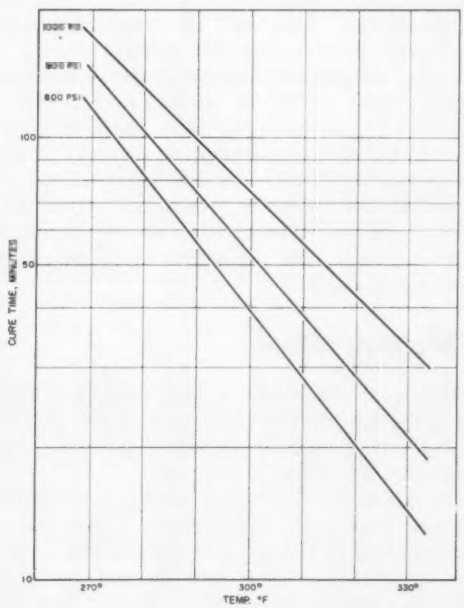

FIG. 7—Values for TC of V via 200 per cent modulus (Compound No. 203).

TABLE II—TEMPERATURE COEFFICIENTS OF VULCANIZATION (10°F.)

Compound	TC (200% Modulus)	TC (Vol. Swell)	TC (Rate Constant)	TC (Average)
200	——	1.28(?)	1.35	1.35
201	1.37	1.39		1.38
202	1.39	1.43	1.39	1.40
203	1.34	1.36		1.35
204	1.34	1.38		1.36
205	1.38	1.35		1.37
206	1.37	1.34		1.36
207 (a)	1.57	1.55		1.56
208 (a)	1.56	1.54		1.55
209 (a)	1.47	1.44		1.45
210 (b)	——	1.56 up to 310°F. then 1.32		1.56 up to 310°F. then 1.32
211	1.38	1.34		1.36
212	1.38	1.36		1.37
213 (c)	1.32	1.37		1.35
214 (c)	1.42	1.39		1.40
A-035	1.40	1.38		1.39
A-150	1.37	1.41		1.39
A-215	1.39	1.43		1.41
A-325	1.40	1.42		1.41
Average Values:				
All Sulfur-Accelerators *	1.37	1.36	1.37	1.37
Single Accelerator *	1.38	1.35	1.37	1.37
Double Accelerator Sulfur—CDMDC Quinoid	1.36 1.37	1.37 1.38		1.36 1.38

* Except CDMDC and ZDMDC.
Notes: a = Sulfur (CDMDC), b = Sulfur (ZDMDC), c = Quinoid.

the other accelerators) is the only source of change in the temperature coefficient of butyl rubber revealed by this study.

The importance of this higher coefficient lies in the lower relative cure rate at low temperatures, which should give processing safety superior to other ultra-accelerators. A comparison of the time-temperature curves for CDMDC-MBTS versus TDEDC-CDMDC-MBTS shows that, at temperatures above 350° F., the reaction rate of the CDMDC-MBTS, with its higher coefficient, does actually "catch up" with the system which had an initially higher rate at the lower temperatures. To strengthen this comparison, TDEDC-CDMDC-MBTS shows the fastest cure at 330° F. of all accelerators studied, reaching a 200 per cent modulus of 900 psi in only 12 minutes.

The TDEDC-CDMDC-MBTS system has been recommended by the accelerator manufacturer *(15)* for its fast curing and low scorch properties. These claims are borne out by this study. The presence of the ultra-accelerator, TDEDC, seems to dilute the effect of CDMDC on the temperature coefficient. The TC value of 1.55 for CDMDC (with or without the secondary accelerator MBTS) and the 1.35 value for TDEDC average out to 1.46 when both are present.

Secondary accelerators do not appear to influence the high coefficients of CDMDC or ZDMDC. The 400° F. cures show further that at high temperatures the coefficients of CDMDC and ZDMDC drop to the normal 1.37. The constancy of the 1.55 coefficient at lower temperatures (as evidenced by the well-defined time-temperature plots) implies a transition point in the vicinity of 330°F. rather than a gradual decrease.

Conclusions in Brief

Two standard laboratory techniques, elastic modulus and equilibrium volume swell, have been used to determine the temperature coefficient of vulcanization for a variety of butyl vulcanizates. With but one exception, both methods gave a coefficient of 1.37 for 10°F. temperature increments (1.76 for 10°C. increments), which was constant over the temperature range studied.

Transition metal salts of dithiocarbamic acid yielded significantly higher coefficients (e.g., 1.55 for 10°F. increments). Since higher coefficients signify greater processing safety (improved "scorch"), but high activity at normal vulcanizing temperatures, the behavior of these transition metal ions in butyl recipes merits further study.

NOMENCLATURE

CDMDC	=	cadmium dimethyl dithiocarbamate
ZDMDC	=	zinc dimethyl dithiocarbamate
LDMDC	=	lead dimethyl dithiocarbamate
BDMDC	=	bismuth dimethyl dithiocarbamate
TDEDC	=	tellurium diethyl dithiocarbamate
MBTS	=	mercaptobenzothiazole

NOTE

Material supplementary to this article has been deposited as Document No. 6152 with the ADI Auxiliary Publications Project. Photoprint or microfilm copies

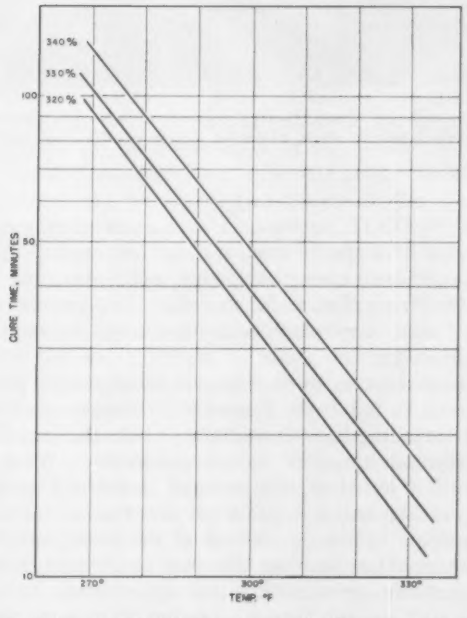

FIG. 8—Values for TC of V via volume swell (Compound No. 203).

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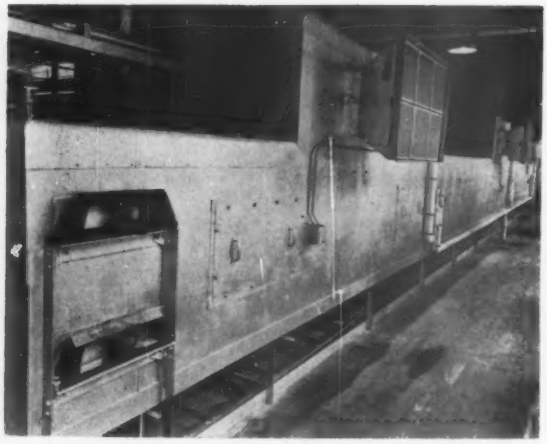
How a Rubber Plant Cures Two 75-Foot Sheets Simultaneously



An over-all view shows the long expanse of the new double-deck oven which permits curing of plastic sponge in extra large sections.

Double-deck oven and special automatic control panel provide continuous curing of spongy plastic-like material

AN 80-FOOT, double-deck oven automatically operated by a special control panel has made possible continuous curing of spongy, plastic-like material by Goodyear Tire & Rubber Co. The system provides even, controlled heat for curing followed by rapid cooling.

In what seems to be a unique arrangement, plastic material is fed from a so-called "making machine" to a threading bar which conveys it to the first deck conveyor at a rate of 40 feet per minute. When 75 feet of it is fed in, the material is cut and another strip of like length is conveyed into the second deck. The two 7-foot wide sections of the plastic are then cured simultaneously by the oven at a predetermined temperature up to 300° F. for eight hours.

Special controls insure a gradual increase to maximum heat for the curing period. At this time, air is recirculated in each of three separate heating zones at a volume of about 5750 cubic feet per minute. Heat is supplied by steam injected from fin-type coils. The coils are located in insulated enclosures on top of the oven, along with the distributing fans.

Rapid cooling at the end of cure is provided by opening the damper on the running exhaust fan, starting a second fan, then opening the fresh air dampers while the recirculating air dampers are shut. The sequence enables temperatures of the curing oven to be dropped below 200° F. before feeding in the next load of material through individually driven chain conveyors. The system was engineered by the Industrial Equipment Division of The R. C. Mahon Co., Detroit, Mich.

Rubber-Based Adhesive for Polyurethane

. . . permits production of foam tape cushioning at reduced cost

The compressible tape is shown here being applied as weather stripping to a street fire alarm.

A NEW, compressible, polyurethane tape that sticks like glue and protects like cotton is expected to find widespread industrial use as a cushioning material in packaging and instrumentation, as thermal insulation for air conditioners and ventilation units, and as a sound and vibration dampener in electrical appliances.

The cushioning tape consists of a two-pound density polyurethane foam with a special rubber-based adhesive applied to a single side. A treated paper laminated over the adhesive protects it and can be peeled off by hand at the time of use.

Designated as Puffoam Cushioning Tape by the manufacturer, Permacel, a division of Johnson & Johnson, New Brunswick, N. J., the tape can be used as a replacement material for felt, cotton, fiberglass, foam rubber, styrofoam, asbestos and cork in various industrial applications. Besides being substantially less expensive, it is expected to offer the additional advantage of greater longevity.

While foam tapes are not unique in industry, previous products have been mainly of the type in which the foam backing is laminated to a film layer containing an adhesive coating. Because of this, Permacel points out, they generally have poor elongation, since their unresilient films will not conform smoothly in cornering. These tapes have been used mainly in the leather fabricating, garment and sundries fields.

Permacel began investigating the feasibility of a single-faced tape about a year ago. Work done in the company pilot plant indicated that applying a rubber-based adhesive directly to the foam base produced a better result than applying the adhesive in strip-film form. It was also found that the direct method cut costs because only half as much adhesive was required to achieve the same bond.

Development engineers assigned to the project requested samples of different types of flexible foam of various densities from several manufacturers. These samples were subjected to critical testing and analysis and, on the basis of results obtained, the company contracted for pilot shipments of two-pound density, flexible polyurethane foam marketed under the name of Nopcofoam by the Nopco Chemical Co., North Arlington, N. J.

The cushioning tape is being made available in three thicknesses—⅛, ¼ and ½-inch—and in widths from one-half inch to 18 inches. Navy Accelerated Aging Tests show that it has an adhesion to steel of 35-40 ounces per inch. Within 72 hours, this set increases to 60-70 ounces, a level at which the foam tears before the bond can be broken.

The tape is inert to chemicals, acids and other solvents. It is also fire retardant and will not absorb water nor sustain fungus. It is able to withstand 250° F. temperatures for extended periods and has a thermal insulating factor of .24-.34 K. Its tensile strength is 3.8 pounds per inch width of ⅛-inch material, about double that of foam rubber; its elongation is rated at 300 per cent.

Following heat treatment, a blanket of granular urethane is inspected on its way to the windup mandrel.

Elevated Temperature Method for Determining

Mooney Viscosity

of Butyl Rubber

By V. B. CALHOUN, J. R. REED and R. M. MINEO

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THE MOONEY viscometer is an instrument which measures the plasticity of elastomers by their resistance to shear. Essentially, the instrument is a closed cavity of fixed dimensions which contains a rotating, serrated disk. The instrument is provided with temperature controls. Resistance of the polymer in the cavity to shear at a given temperature is measured by thrust against the worm gear which drives a serrated disk, and is recorded in Mooney points. *(1)*

The viscometer has been used as a measure of the plasticity of synthetic rubbers since 1942, when it was adopted for use in government rubber plants. Early in its use as a production control instrument, operating conditions were standardized so that values might be comparable throughout the rubber industry. Conditions chosen were eight minutes shearing time with a large rotor at an operating temperature of 212° F. (noted as 8′ ML at 212° F.). A limitation of these conditions in their application to the production of butyl rubber (IIR) is responsible for the investigation reported here.

Limitations on Viscosity Tests

Mooney viscosity determinations of butyl rubber reach an upper limit of about 80 at 212° F., despite increasing molecular weights of the elastomers under test as determined from the viscosity of dilute solutions. Below this limit, Mooney viscosity correlates with Staudinger molecular weight to within about plus or minus 2 Mooney points. Such variation as exists is produced by the combined experimental errors of viscosity and molecular weight determinations, as well as by slight variations in the molecular weight distributions of polymers under test.

These limitations are evident in Figure 1, which presents a graph of Mooney viscosity at 212° F. versus Staudinger molecular weight for butyl polymers of molecular weights in the range 30,000 to 55,000. It may be seen that at this temperature Mooney viscosity reaches a plateau at about 80 Mooney points

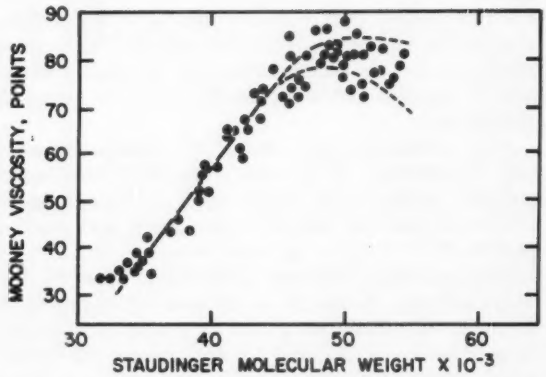

FIG. 1—At 212° F., Mooney viscosities reach a plateau around 80, falling off slowly as molecular weights exceed 48,000. Dotted lines indicate the range of expected values for extremely high molecular weight polymers.

and falls off slowly for polymers of molecular weights greater than 48,000. Butyl polymers of extremely high molecular weights actually produce readings irregularly scattered about values considerably lower than 80 Mooney points. The increased "nerve" or toughness of these higher molecular weight polymers is evident in processing. However, it is not reflected in the polymers' Mooney values at 212° F.

Close control over the production of high molecular weight butyl rubber gained importance as the demand for high Mooney butyl rubber grew in the inner tube industry and, recently, in butyl tire tread applications. Increased production of high molecular weight butyl rubber made it necessary to develop a test modified to include polymers of molecular weight above the range of present specifications and suitable for quality control.

The earliest published treatment of this problem was made by F. L. Roth and G. E. Decker *(2)*. Their investigations showed that the low, erratic nature of readings taken with tough polymers (butyl, styrene

rubber and unmilled Hevea were included in the study) were accounted for by slippage and, in a few instances, crumbling of the polymer in the die cavity. It was found that the problem could be overcome either by decreasing the viscometer's rotor speed or increasing its operating temperature. There were also indications that the problem could be somewhat relieved by altering the design and surface treatment of standard Mooney rotors.

Previously Suggested Improvements

Roth and Decker considered decreased rotor speeds to be the better method of improving the correlation between Mooney viscosity and Staudinger molecular weight. They noted that, while temperatures higher than 212° F. improved the correlation, temperatures even as high as 292° F. did not bring the viscosities of extremely high molecular weight butyl rubbers in line with their expected values. At 260° F., a correlation was obtained for molecular weights below about 69,000. The authors also felt that a Mooney viscometer could not operate long at these elevated temperatures because of temperature control and machine maintenance problems likely to be encountered.

In practice, low rotor speeds have not been used to determine Mooney viscosities for two important reasons. First, an industry standard based on low rotor speeds would require extensive mechanical alteration of existing viscometers and their controls. Second, rotor speeds on the order of 0.01 rpm are required to correlate Mooney viscosity with Staudinger molecular weight for polymers of extremely high molecular weight. Approximately 30 minutes are required for rotor speeds in this range to produce equilibrium values *(2)*. Runs of this length are prohibitive where determinations are made with the frequency essential to quality control. Accordingly, high temperature operation seemed preferable to the use of low rotor speeds.

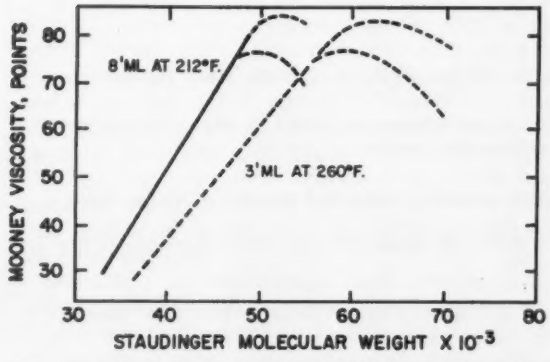

FIG. 2—Further viscosity data for butyl indicate that recommended three-minute shearing time at 260° F. operation extends a viscometer's working range to include butyl polymers of 59,000 Staudinger molecular weight.

TABLE I—REPRODUCIBILITY OF MOONEY DETERMINATIONS

(Y-110 BUTYL RUBBER)

Conditions	3′ ML @ 260°F.		8′ ML @ 212°F.		Extrapolated * 8′ ML @ 212°F.	
Number of Tests	19	24	30	31	19	24
Viscometer Readings:						
High	53.0	53.0	75.0	75.0	75.0	75.0
Low	51.0	50.0	72.0	73.0	72.0	70.0
Average	52.1	52.0	73.6	74.0	73.5	73.1
Standard Deviation	0.8	0.8	0.6	0.7	1.0	1.2

* 8′ ML at 212°F. values extrapolated from 3′ ML at 260°F.

High Temperature Experiments

More than five years of experimental work with elevated temperature determinations (3′ ML at 260° F.) at butyl rubber plants have produced no operating difficulties attributable to high temperature operation of viscometers used with the frequency normal for quality control. Of greater importance perhaps, it has been shown that only 2.1 per cent of the butyl rubber produced in a six-month test period exceeded 59,000 Staudinger molecular weight. This would lead one to expect only an infinitesimal proportion of total production to exceed the correlatable upper limit of 69,000 reported by Roth and Decker.

Elevated temperature testing has an added advantage in that it requires no mechanical change of existing viscometers. Three-minute determinations are rapid and facilitate close quality control. As will be shown later, the accuracy of three-minute determinations at 260° F. is equivalent to that obtained with eight-minute determinations at 212° F.

Mooney values at 212° F. (8′ ML at 212° F.) and at 260° F. (3′ ML at 260° F.) are compared with Staudinger molecular weight in Figure 2. It may be seen that the latter temperature broadens the useful range of Mooney determinations to include higher molecular weight polymers. It is apparent, then, that Mooney values taken for three minutes at 260° F. are a reliable measure of currently produced, high molecular weight butyl rubber, whereas those taken at 212° F. are not.

The curves shown in Figure 2 decrease linearly and converge slightly as molecular weight decreases. Viscosities at 260° F. remain lower than viscosities at 212° F. for all values of molecular weight. Butyl polymers of molecular weight 33,000 and 40,000 have Mooney viscosities between 30 and 55 when measured at 212° F. At 260° F., the viscosities of polymers in this range decrease to values below 30 Mooney points and enter the range wherein experimental error is of significance. From this it is concluded that the viscosity of low molecular weight butyl rubber is still best measured at 212° F.

TABLE II—EXTRAPOLATION OF 8′ MOONEY AT 212°F. FROM 3′ MOONEY AT 260°F.

3′ ML at 260°F.	Extrapolated 8′ ML at 212°F. *									
	0	1	2	3	4	5	6	7	8	9
30	44	45	47	48	49	50	51	53	54	55
40	56	57	58	59	61	62	64	65	67	68
50	70	72	73	75	77	79	81	83	85	87
60	89	91	93	95	97	99	101	103	106	108
70	111	113	117	120	123	126	130	130+	130+	130+

* This table is included so that values reported under the new specifications may be compared with those reported earlier. Conversion between the two systems may be made only at the sacrifice of accuracy. In preparing it, 8′ ML at 212°F. values have been extended beyond their working range.

Maintaining Accuracy

Accuracy is not sacrificed when the viscosities of high molecular weight polymers are determined for three minutes or 260° F. Table I presents the results of a series of viscosity determinations made with Y-110 butyl rubber. (Y-110 designates a particular, large sample of butyl rubber of closely controlled characteristics distributed by the Bureau of Standards for use as a standard of molecular weight, cure rate, etc.) These tests were made to compare the accuracy of viscosity determinations made for three minutes at 260° F. with that of eight-minute, 212° F. values. Standard deviations of 0.8 and 0.6-0.7 for 3′ ML 260° F. and 8′ ML 212° F., respectively, are comparable and, in both cases, satisfactory.

Experience with 8′ ML 212° F. Mooney viscosity is extensive in the rubber industry. A conversion chart is presented in Table II for those who may prefer to refer 3′ ML 260° F. values to 212° F. Data for this table have been extrapolated to extend beyond the accurate range of determinations made at 212° F. Conversion multiplies the apparent experimental error to an objectionable level, however, and is therefore inadvisable. To illustrate this point, Table I also contains 3′ ML at 260° F. values converted to 8′ ML at 212° F. for Y-110 butyl rubber. The standard deviation of converted values is 1.0-1.2 and, as a result, conversion produces an expected variation of ±2.0-2.4 Mooney points at a 95 per cent confidence level.

Principal Findings

There were three principal findings of this investigation on Mooney viscosity. First, 3′ ML at 260° F. is a more accurate definition of currently produced high molecular weight butyl rubber than 8′ ML at 212° F. Eight-minute determinations at 212° F. are still recommended for low molecular weight polymers, however, since 260° F. values for polymers below 40,000 Staudinger molecular weight are inaccurate.

Second, a standard deviation of 0.8 is obtained with 3′ ML at 260° F. This figure is equivalent to the experimental error at 212° F. Finally, all butyl polymers currently being produced do not exceed molecular weights which can be correlated accurately with Mooney viscosities determined at 260° F.

LITERATURE REFERENCES

(1) Mooney, M., *Ind. Eng. Chem.* (Anal. Ed.), Vol. 6, p. 147 (1934).
(2) Roth, F. C., and Decker, G. E., *India Rubber World*. Vol. 128, pp. 339-43 (1953).

Coming Soon . . .

Improved Butyl Rubber Vulcanizates—By C. J. Jankowski, K. W. Powers and R. L. Zapp, Enjay Laboratories, Linden, N. J.

How superior butyl rubber vulcanizates are obtained by replacing normal surfur loading and accelerator with sulfur donor and low sulfur-high accelerator vulcanization systems.

The Theory of Rubber Elasticity—By Dr. P. J. Flory, Institute of Rubber Research, University of Akron, Akron, Ohio.

Major theoretical postulates of the rubber elasticity theory are spelled out and further investigations into structure proteins recommended.

Radiation Resistance in Polysiloxane Elastomers—By David J. Fischer, Polymer Research Lab, Dow Corning Corp., Midland, Mich.

Experiments were conducted on a new series of polymers showing particular promise for use in radiation environment applications.

A comparative study of thermal black and ground calcium carbonate . . .

Fillers in Cross-Linked Polyethylene

By W. F. ABBEY, B. C. CARLSON and R. T. ZIMMERMAN
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SOME time ago a new engineering composition was introduced and became of immediate interest to the wire and cable industry. This composition was vulcanized or cross-linked polyethylene, filled with medium thermal black and containing an antioxidant. Patent number 2,888,424, assigned to the General Electric Company, concerned cross-linking polyethylene with certain peroxides and containing defined fillers.

The purpose of this paper is: (1) to compare physical and electrical properties of medium thermal black filled, cross-linked polyethylene with natural ground calcium carbonate filled, cross-linked polyethylene and (2) to describe the changes in physical and electrical properties of these compositions as the degree of cross-linking is varied, by altering either the quantity of cross-linking agent or the length of cure.

Compounding of Test Batches

The variations in compositions examined are shown in Table I. The low density polyethylene resin had a specific gravity of 0.92 and a melt index of 2. Agerite Resin D, polymerized trimethyl dihydroquinoline, was used as the antioxidant because it imparts excellent heat resistance to the composition and because it is one of the few antioxidants having a minimum adverse effect on the cure rate. Separate investigation has shown 0.5 parts per 100 of polyethylene to be optimum dosage of Agerite Resin D for the purpose of this particular study.

Thermax, a medium thermal black, appears to be uniquely suited for use in peroxide cross-linked polyethylene among the many available carbon blacks. It provides good reinforcing properties, with the least increase in compound viscosity of all types of carbon black. It has a minimum effect on the electrical properties of the finished composition and has little adverse effect on the peroxide during cross-linking.

Atomite, a natural ground calcium carbonate, was selected as an inorganic filler having no adverse effect on the peroxide during cross-linking. The fillers in this composition were evaluated at three volume loadings. Varox, a 50 per cent active material containing equal parts of 2,5-bis(tertiary butyl peroxy)-2,5-dimethyl hexane and an inert mineral carrier, was used as the peroxide cross-linking agent. This material is stable in storage and provides wide latitude in processing safety while effecting rapid cross-linking at curing temperatures.

The resin, filler, and antioxidant were loaded into a size B Banbury and fluxed 10 minutes at 250-260° F. The Varox was then added and the mixing continued for an additional three minutes. After discharge from the Banbury, the stock was sheeted off on a mill with rolls heated to 200-220° F. Slab curing was conducted in a press through a range of 10 to 120 minutes at 320° F.

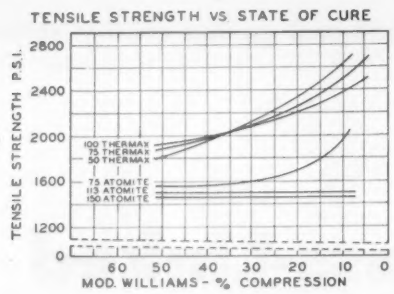
Test Apparatus and Technique

Processing characteristics were studied by means of Mooney scorch tests at 270° F. In addition, extrusion characteristics were studied by making Garvey die extrusions using a Royle No. 1 Spirod extruder fitted with a crosshead.

The state of cure was determined by a modification of the Williams plastometer procedure whereby the per cent compression of a sample was measured at a temperature above the softening point of thermoplastic polyethylene. In this method, an 0.5 square inch sample, which was approximately 0.3-inch high

Note: This paper was presented before the Eighth Annual Technical Symposium on Communication Wire and Cable of the U. S. Army Signal Research and Development Laboratory, held at Asbury Park, N. J., December 1-3, 1959.

10 Figures Illustrate Data on Cure, Aging and Electrical Properties



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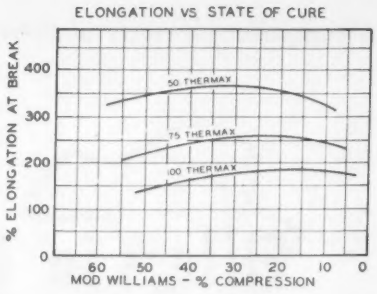

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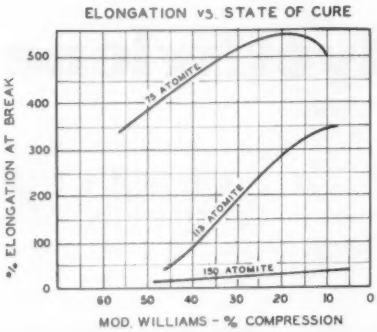

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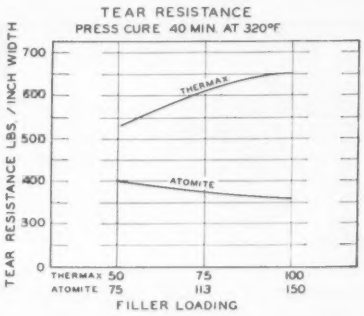

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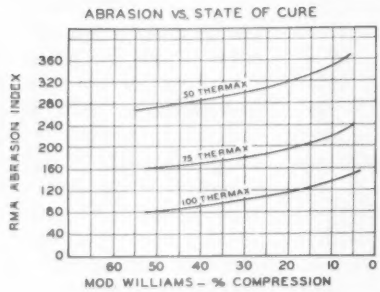

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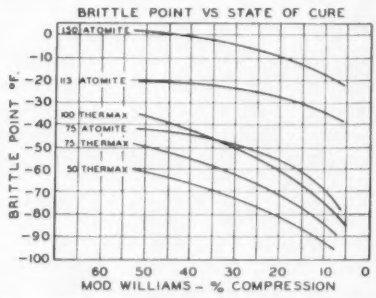

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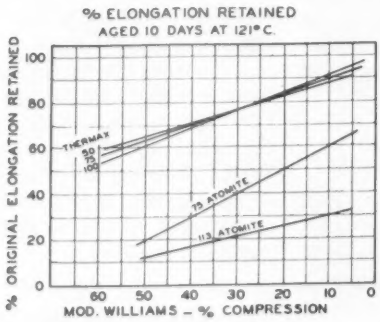

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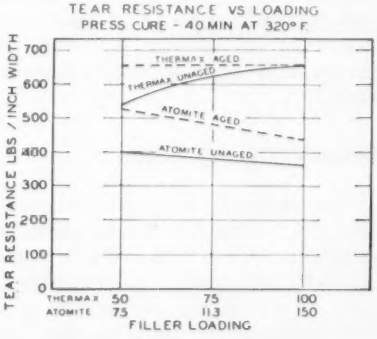

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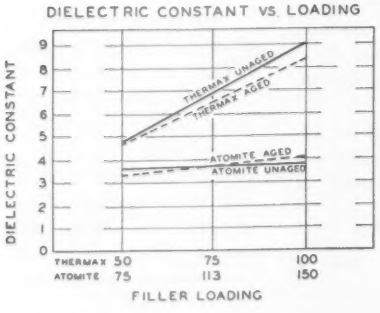

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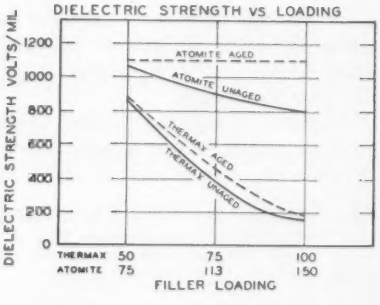

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is prepared from four plies of a tensile slab of approximately 0.075-inch gauge. The sample is placed between the platens of a Williams plastometer maintained in a circulating air oven at 250° F. The load applied is 10 kg. The per cent compression is calculated from the height of the sample at the start of the test and after 30 minutes. The compression is compared with a thermoplastic sample which is considered as a standard. This standard gives a compression value of approximately 80 per cent.

The tensile properties were obtained on a Scott tensile machine (A.S.T.M. D-412-51T) at 20 inches per minute. Tear resistance was also tested on the Scott machine (A.S.T.M. D-624-54) at 20 inches per minute. Die A method with a 0.02-inch nick was used.

Abrasion resistance was obtained on a National Bureau of Standards Abrader by the R.M.A. procedure using a standard rubber tread compound for comparison. Low temperature brittle point was studied in an American Instrument Company cold box using dry ice as the cooling medium. A flexing break technique was employed for brittle point determination (A.S.T.M. D-736-54T).

Electrical volume resistivity was determined on a tensile slab at 70° C. by means of a megohmmeter. Dielectric constant and per cent power factor were obtained on a type 260A Boonton Radio Corporation "Q" Meter. These properties were measured at a frequency of 100 kc. at room temperature. Samples 2 inches in diameter and approximately 0.075 inch thick were assembled between aluminum foil for the determination of these two properties. Dielectric strength was determined by a short time test at 60 cycles, similar to that described in A.S.T.M. D-149-55T, using a 5 x 6 x 0.025-inch slab sample.

Processing Data Compared

Mooney scorch data at 270° F. on these stocks is described in Tables II and III. Thermax and Atomite are compared at equal volume loadings at three different levels.

It will be noted that there is adequate processing safety with Varox at the 4- and 6-part level. These scorch data at 270° F. suggest that even higher processing temperatures could be used safely. Some advantage in processing safety is obtained with Thermax over Atomite. Atomite tends to become increasingly scorchy with heigher loadings; it also develops a stiffer stock, as indicated by the viscosity readings.

TABLE I—CROSS-LINKED POLYETHYLENE FORMULATIONS

Low Density Polyethylene	100
Agerite® Resin D	0.5
Loadings of Thermax®	50— 75—100
Loadings of Atomite	75—113—150
Varox	4—6

TABLE II—MOONEY SCORCH AT 270° F.

Low Density Polyethylene	100	100	100
Agerite Resin D	0.5	0.5	0.5
Thermax	50	75	100
Varox (4)—Scorch Time (min.)	46	48	50
Viscosity	9.5	11	14
Varox (6)—Scorch Time (min.)	37	37	35
Viscosity	9	11	15

TABLE III—MOONEY SCORCH AT 270° F.

Low Density Polyethylene	100	100	100
Agerite Resin D	0.5	0.5	0.5
Atomite	75	113	150
Varox (4)—Scorch Time (min.)	35	29	22
Viscosity	11	15	20
Varox (6)—Scorch Time (min.)	23	21	16
Viscosity	12	15	20

When these stocks were extruded through a Garvey die at 250° F., smooth surfaces were obtained with no irregularity of the knife edge. Some swelling was noted with the 50-part Thermax loading. At the other Thermax loadings and at all Atomite loadings there was little evidence of swell. When these extrusions were conducted at 290-300° F. head and die temperatures, slight indications of roughness were noted. Apparently some gelling had taken place, particularly at the higher level of Varox and with the use of Atomite as the filler.

Thus, we see from the Mooney data and from extrusions made through a Garvey die, that there is adequate processing safety in a temperature range necessary to obtain the required surface appearance. The proper form stability of the extruded article may also be obtained by proper volume loading of filler and temperature control.

State of Cure Measurements

The modified Williams per cent compression test for determination of state of cure is illustrated in Table IV. It is apparent that, as the cure time and the Varox content are increased, the per cent compression at 250° F. decreases. This affords a convenient method of relating properties of the polyethylene to the degree of cross-linking.

Tensile strength may be related to state of cure, as shown in Figure 1. The tensile strength is directly related to the state of cure in a Thermax-loaded stock, but is not so apparent in the case of Atomite, particularly at the higher loadings. From the higher level of tensile strength obtained with Thermax, we see a definite advantage in the use of medium thermal black over an inorganic filler. This is shown also in Figures 2 and 3 where elongation at break is related to state of cure. Elongation goes through a maximum at a point between a relatively low and a relatively high degree of cross-linking, when Thermax is used as a

filler at all loadings. When Atomite is used as a filler, this same phenomenon appears to take place at the low loading only where a relatively high "stretch-out" is obtained, while at the high loading a "short" and somewhat brittle compound is produced.

Tear resistance does not appear to be influenced to any great degree by the state of cure but does seem to be related to the loading. Figure 4 compares the tear resistance of Thermax- and Atomite-loaded stocks. Figure 5 compares abrasion with state of cure for three levels of Thermax. Resistance to abrasion appears to be improved as the state of cure is increased. The Atomite-loaded stocks did not exhibit this trend, and their abrasion resistance appeared to be inferior to the carbon black-loaded stocks.

Low temperature brittle point is also related to state of cure. Again we see the advantage in developing a high state of cure by referring to Figure 6. It can be seen that there are definite limitations to the quantities of fillers which can be used before they change the low temperature properties. However, with Thermax as a filler and a high degree of cross-linking, embrittlement temperatures below —90° F. were obtained.

Aging and Electrical Properties

Since elongation is probably of greater interest than tensile strength which remains essentially constant, the change in elongation after hot air aging is shown in Figure 7. As the state of cure is increased, the per cent of the original elongation retained after aging also increases. This occurred essentially equally for the three levels of Thermax studied, but fell off as the Atomite loading was increased. With the 150-part loading of Atomite, many of the aged samples became quite brittle, making it difficult to establish any relationship between original and aged properties; therefore, no curve is shown for 150 Atomite loading.

Tear resistance after aging 10 days at 121° C. is shown for a typical cure of 40 minutes at 320° F. in Figure 8. It is interesting to note that tear strength is not reduced by hot air aging.

Although there are indications that the electrical properties are improved by an increase in the state of cure, the most pronounced changes are effected by the type of filler used and the changes in volume loading.

Volume resistivity measurements approached or exceeded the limitations of our equipment. Thus, few comparisons can be made. The data shown in Tables V and VI are indicative of the range of electrical resistivity only. It will be noted, however, that Thermax develops higher resistivity than Atomite on the unaged samples. Aging appears to improve this property in the case of the latter filler.

In the case of dielectric constant measurements, the greatest change in constant was found when the Thermax loading was changed as shown in Figure 9. Here we see a marked increase in dielectric constant as Thermax loading is increased. The increase in loading of inorganic filler does not change the dielectric constant appreciably and develops considerably lower values than Thermax. It is interesting to note that aging for 10 days at 121° C. does not affect this electrical property.

The per cent power factor values were somewhat erratic. The results can be summarized by stating that, in general, the values obtained by the use of Atomite were lower than with Thermax. Much the same relationship was obtained as is pictured in Figure 9 for dielectric constant data.

Figure 10 illustrates the dielectric strength measurements made on the compositions loaded with three levels each of Atomite and Thermax. Again, little difference was found between times of cure. Atomite, it will be noted, develops higher dielectric strength than Thermax does, and we see only a slight drop-off as Atomite loading is increased. It is interesting also that dielectric strength is not adversely affected by aging 10 days at 121° C. with either loading material.

TABLE IV—MODIFIED WILLAMS PER CENT COMPRESSION

Low Density Polyethylene	100	100
Thermax	100	100
Agerite Resin D	0.5	0.5
Varox	4	6
Press Cures at 320° F.:		
10 min.	52	33
20 min.	33	14
40 min.	16	7.0
80 min.	11	3.4
120 min.	8.1	3.0

TABLE V—VOLUME RESISTIVITY—THERMAX-LOADED STOCK

	Ohm Cm. at 70° C.		
Low Density Polyethylene	100	100	100
Agerite Resin D	0.5	0.5	0.5
Varox	4	4	4
Thermax	50	75	100
Press Cured 80 Minutes at 320° F.:			
Original	$>8.1 \times 10^{14}$	$>8.9 \times 10^{14}$	5.7×10^{14}
Aged 10 Days at 121° C.	$>7.8 \times 10^{14}$	$>7.9 \times 10^{14}$	$>7.7 \times 10^{14}$

TABLE VI—VOLUME RESISTIVITY—ATOMITE-LOADED STOCK

	Ohm Cm. at 70° C.		
Low Density Polyethylene	100	100	100
Agerite Resin D	0.5	0.5	0.5
Varox	4	4	4
Atomite	75	113	150
Press Cured 80 Minutes at 320° F.:			
Original	$>8.7 \times 10^{14}$	2×10^{14}	5.3×10^{14}
Aged 10 Days at 121° C.	$>7.9 \times 10^{14}$	$>7.8 \times 10^{14}$	$>8.1 \times 10^{14}$

SPECIAL INDUSTRY REPORT

Budgeting
in the Smaller Rubber Plant

FEW, if any techniques are more vital to sound management than budgeting. Many smaller and medium-sized rubber companies unwisely neglect or ignore this simple, effective tool. Invariably they have a great need for it because of pressing demands for profitable utilization of working capital, which is tight in the rubber industry, and in order to develop sound plans for meeting competition and for expanding.

Company budgets have sometimes been confused with municipal budgets, in which expenditures over a long future period must be geared closely to appropriations or anticipated revenues. Business budgets, however, are flexible forecasts, not static rules, and have a different purpose. By and large, they do three things: Show pre-planned activities for each division of the company; Coordinate activities of different departments and divisions; Permit control by comparing actual results with planned activities and/or dollar income and expenses.

Primary Planning Level

Budgeting applies to the whole field of management. Therefore, all division heads must be made personally responsible for planning the activities in their own jurisdictions. In this way, as they set goals for their individual units, they must necessarily consider past performance together with realizable efficiency under expected future conditions. These men, after becoming budget-conscious, will usually do all they can to make actual performance match budgeted figures or improve on them, if possible.

Which products are going to be sold? How much of each? Will the volume vary by season, affecting deliveries? Answers to these questions are the fundamental points on which the activities of a business will hinge. The sales department must supply the answers. For rubber plants, it is preferable that the expected volume be expressed in units as well as in dollars.

This is the point at which many budgetary programs hesitate, stop and are abandoned. Innumerable reasons can be given for a sales department's apparent inability to forecast because of unavailable facts, unforeseen events and unpredictable conditions. Nevertheless, a sales budget must be developed one way or another. The effective sales manager makes the best use he can of the information he can get and goes ahead. Of course, it must be expected that variances will develop from originally budgeted figures. Every budget must be accepted on that basis. If a sales forecast is not made, the plant manager, the purchasing agent or the treasurer cannot arrange to obtain the needed facilities, new materials and capital.

Estimating Future Sales

In making his budget, the sales manager will presumably have studied the economic state of the nation, the past performance and future potentialities of various market areas, and the volume—in units and dollars—which can reasonably be attained with maximum profitability to the company. They represent the raw materials, so to speak, which must later be processed.

As soon as the sales-volume budget is completed, the sales-expense budget must be prepared. It should show the complete amount of proposed expenditures—item by item—which will be required to advertise, sell and distribute the budgeted volume of finished goods.

It should be noted in the preparation of all budgets that future revisions as well as procedures used for costing and pricing will be simplified if items of fixed and variable expense are listed in separate classifications. In the fixed-expense group would be such items as executive salaries, real estate taxes and building rent, which are essentially the same over a period of time regardless of the volume of operations. On the other hand, variable-expense items would include direct labor, materials, transportation and machinery power, which vary directly with the amount of business the plant does. Careful classifications of this sort make it possible to calculate break-even points, and to forecast expenditures and company profit at varying levels of production.

Coordinating Production Costs

The sales-volume budget should be given to the head of operations, who is responsible for turning out at minimum cost the finished goods required by the sales department in quantities needed for specific deliveries. Operations must be carried on at a level which utilizes the machinery efficiently, maintains the labor force without excessive turnover, and keeps down waste. The plant manager should get assistance from the controller on the classification of certain fixed charges like taxes or rent, and in the allocations of other general expenses.

Replacing fiscal guesswork with budgeting—

Sound business planning has grown to recognize the need for replacing executive guesswork by modern administrative methods. Properly used, these new techniques facilitate rather than inhibit the making of basic decisions regarding production, sales and investments. Even the small and medium-sized units in the rubber industry must rationalize their operations in order to compete or expand successfully.

One of the most salient features of proper planning from idea to finished product consists of drafting and implementing a sound budget. The editors of RUBBER AGE asked Howard E. Sommer, a veteran management consultant with extensive experience in the rubber field, to prepare this article outlining basic procedures to be followed by smaller concerns for flexible budgeting. Mr. Sommer is a partner and general manager of Wolf Management Engineering Company, 7 S. Dearborn St., Chicago, Ill.

Mr. Sommer has prepared a check chart for the further guidance of budgets and business management. Entitled "Sound and Progressive Management," it is available to our readers upon request.

Drawing up a budget is only the initial step in the establishment of a financial plan that offers the rubber producer continuous control of his production timetable.

Although typically the use of materials and supplies is controlled by the plant manager, the price of these items must be settled elsewhere. For this reason, it becomes necessary to draw up a purchasing budget concurrently with the manufacturing budget.

After surveying existing raw materials inventories and estimating future production in the light of probable prices of major materials and supply items, the purchasing agent, perhaps in collaboration with the plant manager, is able to set up a purchasing budget. Subsequently, it will become part of both, the manufacturing budget—which thereby becomes really a complete cost-of-manufacturing budget—and the financial budget. Clearly, it must be reflected in the latter because cash has to be available at certain dates to pay for purchases.

Final Budget Allocations

The controller, in conference with the president of the company, should set up a budget in which all items of administrative and general office expense are properly allocated.

All of the foregoing budgets then go to the treasurer or controller. He combines them, adding sundry items of income and expense, and also computes taxes. Referring to payments which must be made on specified dates, he can make a tentative statement showing the cash position at the end of each forecasted month. By the same token, he can estimate how much money, if any, must be borrowed and at what cost; also how much can be invested for the long and short term. With all financial credits and charges included, the master budget is finished, giving a complete picture of planned activities and goals to be accomplished by the entire company in the ensuing period.

Each time monthly statements are drawn up by the accounting staff, a summary sheet can be made showing actual results of operations, budgeted amounts and percentages of budget attainment. Variations will, of course, be evident, but any discrepancies can be immediately investigated and steps for improvement taken, when necessary. A major continuing deviation, which seems to be indicative of a long-term trend, might well cause a revision in both the budget and management thinking.

Insuring Successful Control

In a business of 25 persons or less, all the operations discussed above can be performed by the owner or active head, with the aid of salesmen and the chief foreman, and, of course, with the advice and counsel of his certified public accountant. In a medium or large size business, the mechanisms become more complex.

In a business having 75 to 125 employees or more, the operating head of the business distributes the work as was mentioned previously, but maintains a personal interest at all times. A meeting should be held at the close of each fiscal period and the budgeted operations of all departments as well as each category of expense in every department, should be reviewed. These budgetary control meetings are the lifeblood of the operation. They determine whether or not the entire budget will succeed or fail in its mission of controlling expenses.

Budgets are based on educated guesses. To be effective, budgets must be reviewed at the end of each month or other budgeting period. Adjusting for odd dollars and cents could lead to a spurious exactness which is undesirable, to say nothing of the tremendous amount of additional labor required to compute these extra odd figures. Budgets cost money in terms of hours spent on them by the company's own officers and employees. However, a good budget well run, seriously administered and faithfully followed through, cannot fail to accrue benefits far beyond the expenses involved.

Thus, the budget is actually a timetable by which management may engineer its business to a successful annual conclusion. It may also serve as a device to determine whether or not the business is, from one budgeting period to the next, "operating on time" to achieve its corporate objective.

R/A Special Industry Reports Coming Soon . . .

Towards More Efficient Purchasing

Purchasing techniques used by rubber manufacturers are being re-examined in the light of the fact that the services performed by natural rubber, synthetic elastomers and plastics have multiplied and diversified.

Materials Control for Small Rubber Plants

Because they have lacked an adequate materials control program, many rubber companies find themselves choked off from further growth just when the sales and orders situation is best.

Auto Fleet Leasing in the Rubber Industry—Your Questions Answered

A series of 12 questions and answers point up the extent to which leasing has been accepted by the rubber industry and spotlight some of the pros and cons of switching from company-owned fleets.

How to Pick Your New Plant Site

A comprehensive outline for companies investigating the possibility of new sites which will enable them to take advantage of shifting markets, mounting freight costs and new labor pools.

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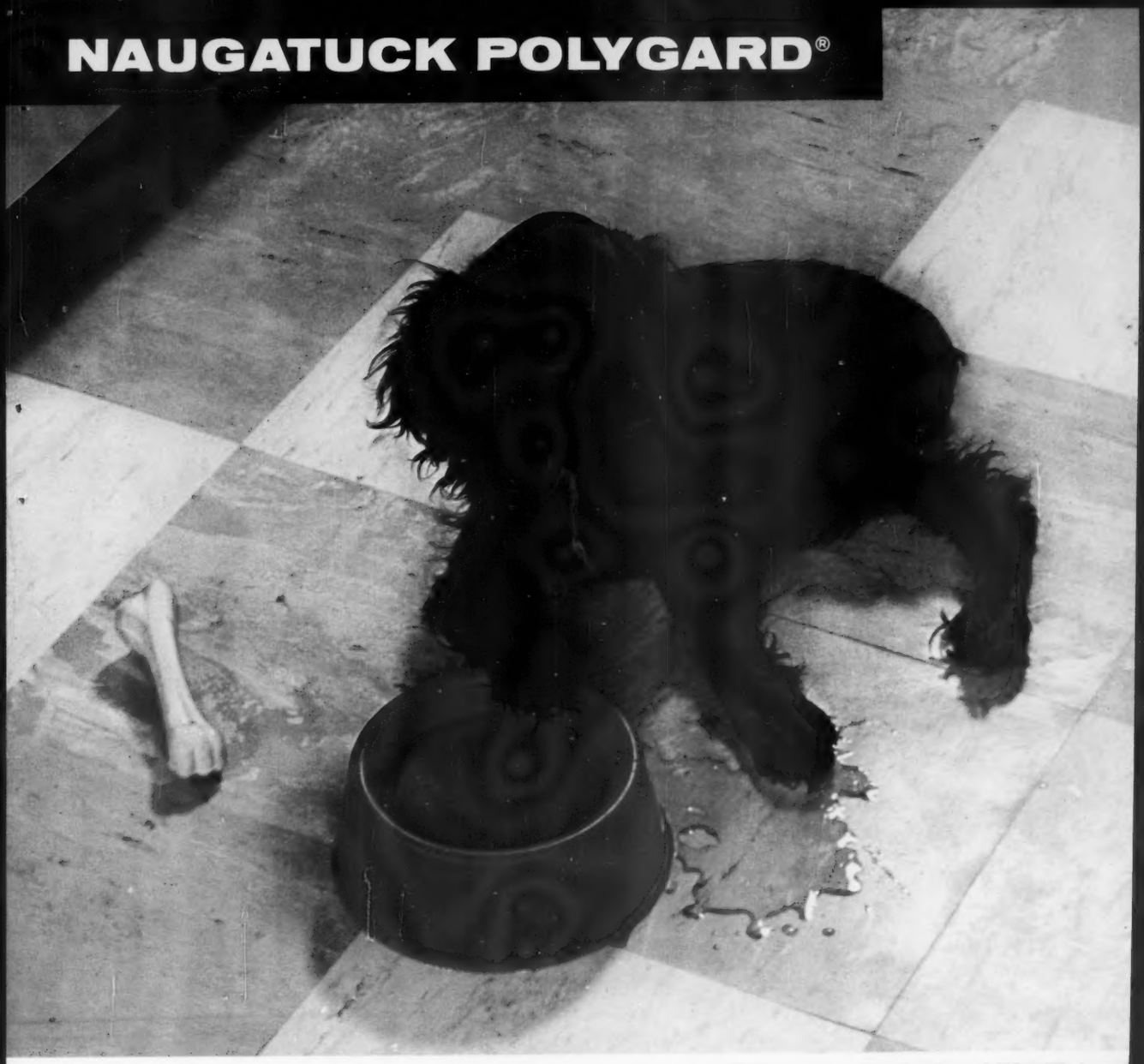

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Elongation at Break (%)	430
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Heavy Calcined Magnesia	12.5
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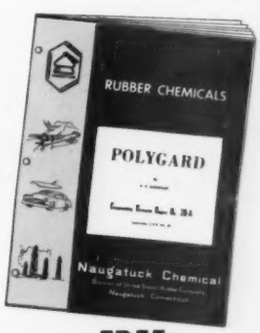
Stearic Acid	2.0
SUNPROOF JR.®	2.0
Titanox RA	20.0
Hard Clay	200.0
Dry Ground Whiting	150.0
M-B-T-S	2.5
B-I-K	1.25
RETARDER E-S-E-N	0.5
	536.25

PHYSICAL PROPERTIES
(Cure 6 min. at 325°F.)

Mooney Scorch at 250°F.	8'
10% Modulus	720
Tensile Strength	920
Elongation	60
Hardness (Shore D)	45



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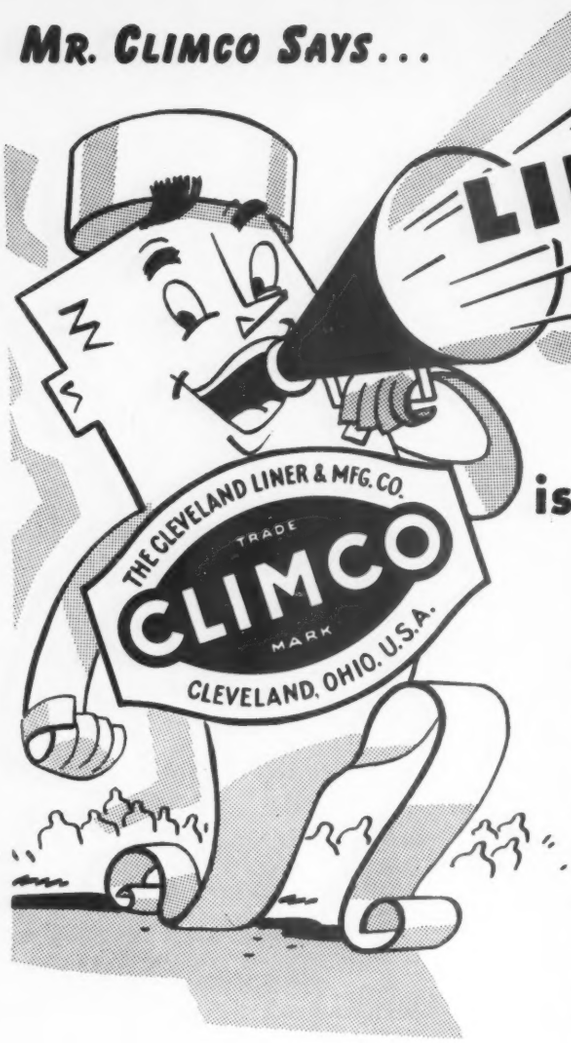

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EDITORIAL

The Big Gap

► $4 billion is a lot of money. $4 billion is the estimated deficit in the balance of trade between the United States and the rest of the world in 1960. The United States is rapidly pricing itself out of world markets. What to do?

As far as many manufactured goods (including rubber products) are concerned, this country is continuing to lose ground in the struggle for foreign markets. Exports have declined by something like 26 per cent from peak levels, and domestic prices have risen far more sharply than British or German prices. A recent survey has shown that the wages of steel workers in the United States are three times as high as their British counterparts. Not only are exports to Western Europe dropping, exports to Latin America are also falling alarmingly. It is a significant fact that even in some cases where the United States is willing to give loans or grants to foreign countries, there is reluctance to buy American capital equipment because the costs are so much higher than similar equipment in Western Europe.

The *British Trade Journal and Export World* has gone so far as to suggest that our currency should be devalued so that it is in line with the international assessment of its value. "Were it any currency but the dollar, a revaluation would seem inevitable," the publication declares.

It would seem, on the face of it, that American industry has taken the fall in its exports with remarkable calm without any unusual demands for government action. The view has been advanced that U. S. industry is reconciled to this loss of markets and has already made its plans for meeting the situation by increased investments in overseas facilities.

One added factor: When the European Common Market is in full operation, and when the "Outer Seven" are in full swing, the loss of United States exports to those countries will be of considerable magnitude. At that time, it is estimated, four out of five American corporations now shipping abroad will be manufacturing in Western Europe or will have entered into licensing arrangements.

What does this all mean to the rubber industry? Will the time come when we will have no domestic rubber boot industry? When we will have no domestic rubber household goods industry? When we will have no domestic tire industry? Will the world be divided into manufacturing regions —boots from Japan—household goods from Germany—tires from Italy? In which direction are we heading? Is United States industry becoming no more than an investor?

The rubber industry—and all domestic industry for that matter—should begin to ask questions—to reassess and re-evaluate. Our technical superiority may be slipping into other hands, according to some. Is our manufacturing superiority also going by the boards? What's going on here?

NEWS REPORTS

and industry activities

FEBRUARY, 1960

Division of Rubber Chemistry Schedules Spring Meeting

► Division of Rubber Chemistry of the American Chemical Society plans to hold four technical sessions at its spring meeting, which will be held on May 4 to 6 at the Statler Hilton Hotel in Buffalo, N. Y. Highlights of the meeting will be the presentation of the Goodyear Medal, scroll and honorarium to Dr. W. B. Wiegand, special lectures and the regular meeting of the 25-Year Club.

Dr. Wiegand, retired vice-president in charge of research for the Columbian Carbon Co., was selected the recipient of the 1960 Charles Goodyear Medal at the Washington International Conference for research on reinforcement of rubber by carbon black. His lecture, entitled "Determinants in Research," will be delivered at 11 a.m., Wednesday, May 4, at the business meeting. The medal, scroll and honorarium will be presented by the chairman to the medalist at the banquet.

A special lecture will be presented by Professor P. Debye at one of the Thursday sessions. He will speak on "Latest Advances and Break-Throughs in the Physics of Polymers." Professor Debye (retired) is a Nobel Prize winner in chemistry for original contributions on molecular structure. He is located at Cornell University. At the other Thursday meeting, Professor H. Mark will speak on "Latest Advances and Break-Throughs in the Chemistry of Polymers and Polymerization." Professor Mark (retired) is an international authority on polymer chemistry and is located at Brooklyn Polytechnic Institute.

The 25-Year Group, with C. H. Peterson presiding, will meet on Wednesday, May 4, prior to the first technical session. This session will begin at 2 p.m. and will be chaired by W. J. Sparks. Four sessions for general or contributed papers are planned. Those who wish to present papers at these technical sessions should submit seven abstracts to the secretary before March 10, 1960. At least one of the authors must be a member of the A. C. S. Abstracts should be of about 200 words each and should be submitted with a letter of transmittal containing the following data: (1) The laboratory in which the work was done; (2) Who will deliver the paper; and (3) How much time is requested.

Abstracts should answer three specific questions: (1) Why was the work undertaken? (2) What were the results? and (3) Do you think the results will be useful to chemists and chemical engineers and of general significance to science? Six copies of the paper, ready for publication (not lectern copies), are to be delivered to the secretary prior to the meeting or immediately after presentation.

Industry Contract Dates

► April, May and June are the key months of 1960 as far as the rubber industry's Big Four — Firestone, Goodyear, Goodrich and U. S. Rubber—are concerned, since contract and wage negotiations, affecting some 80,000 rubber workers, can be reopened. The present contracts between the United Rubber Workers and Firestone and Goodyear expire in April 1961, while the agreements with U. S. Rubber and Goodrich expire in May and June 1961, respectively.

Suspend Trading on Stock

► Governors of the New York Stock Exchange suspended trading on January 4 on two issues of General Tire & Rubber Co., Akron, Ohio, its 4½ per cent cumulative convertible preference stock and its 4¼ per cent cumulative preferred. According to the NYSE, the number of publicly held shares in each issue has fallen below the point where it considers the shares suitable for trading. Application will be made by NYSE to the Securities and Exchange Commission to delist the issues. The NYSE states that out of 100,000 issued shares of General Tire's 4½ per cent preferred, 97,387 shares have been converted, leaving 2,613 shares held by 60 stockholders. General Tire's 4¼ per cent issues have declined from 75,000 shares to 4,915 held by 130 shareholders. The action does not affect other listed General Tire issues such as its common stock and $5 and 5½ per cent cumulative preferred issues.

Rubber Production-Consumption Set New Record in 1959

► Rubber Manufacturers Association, New York, N. Y., reports that consumption of new rubber in the United States during 1959 established the highest year on record, amounting to 1,628,013 long tons as compared with the previous all time high of 1,529,699 long tons used in 1955. This exceeds the 1958 consumption of 1,364,404 long tons.

Consumption of all types of synthetic rubber amounting to 1,072,759 long tons in 1959 also reached a new record high, as compared with the previous high of 925,879 long tons used in 1957, and the 879,912 long tons consumed in 1958. Natural rubber consumption came to 555,254 long tons in 1959, as compared with 484,492 long tons used in 1958. Of the total new rubber consumed in 1959, synthetic rubber amounted to 65.89 per cent, exceeding the 1958 ratio of 64.49 per cent.

Production of synthetic rubber for 1959 established a new yearly high of 1,379,849 long tons, as compared with a previous all time high of 1,118,173 long tons produced in 1957, and surpassing 1958's production of 1,054,625 long tons. For 1959, reclaimed rubber consumption came to 286,523 long tons, as compared to the 248,156 long tons used in 1958. Total new rubber consumption for December was 133,645 long tons, as compared with 125,922 long tons consumed in November.

Synthetic rubber consumption in December came to 90,485 long tons, an increase of 7.87 per cent over the November consumption of 83,883 long tons. Natural rubber consumed during December was 43,160 long tons, as compared with November's consumption of 42,039 long tons. Synthetic rubber during December accounted for 67.71 per cent of total new rubber consumption, a new high level, as compared with the previous high of 66.78 per cent reached in October and passing the November ratio of 66.62 per cent. Production of synthetic rubber during December was 125,976 long tons, as compared to the 124,825 long tons produced during November. Reclaimed rubber consumption for December was 23,075 long tons, an increase over the 20,217 long tons consumed during November.

Natural Rubber Conference

► An International Conference on Natural Rubber Research will be sponsored by the Rubber Research Institute of Malaya with the support of the government of the Federation of Malaya and the Rubber Producers' Council. Scheduled to take place in Kuala Lumpur from September 26 to October 1, the conference will be held in two sections running concurrently. One section will be devoted to research on natural rubber production, while the other will deal with research on the preparation and use of natural rubber and latex.

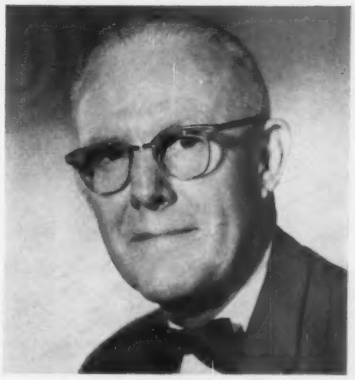
Schedule for those submitting papers is as follows: Submit title, February 1; Abstract of not more than 250 words, April 1; Completed manuscript in double-spaced typescript, July 15. Papers may be contributed in English or French under the following subjects, provisionally grouped into sessions: **Production**—Nutrition; Ground covers, weed control; Ecology, environment; Breeding and selection, vegetative propagation; Tapping, yield stimulation; Pests and diseases. **Chemistry of the Product**—Biochemistry of latex; Microbiology of latex; Chemistry and technology of dry rubber; Chemistry and technology of latex; Factory practice and allied subjects. Correspondence should be addressed to Rubber Research Institute of Malaya (Rubber Conference), P. O. Box 150, Kuala Lumpur, Malaya.

ICC Permits Use of Rubber Tanks

► In the most recent of a long series of hearings, an Interstate Commerce Commission examiner recommended that no federal restrictions be placed on the use of versatile rubber tanks. However, it was specified that the tanks be limited to sizes under 1000 gallons. This recommendation is believed to be a compromise between the positions of the tank-truck industry and the general commodity carriers. Tank-truckers oppose the use of the rubber tanks by general cargo carriers, charging that they lack proper operating authority from ICC. The tank-truck operators have made sizable investments in specialized equipment. Widespread use of the collapsible rubber tanks (on flat-bed trucks) conceivably could edge into tank truckers' business. Final ICC decision on the issue is not expected until next year.

Esso Merges With Humble

► On January 1, 1960, Esso Standard Oil Co. merged with Humble Oil & Refining Co., a newly created Delaware corporation. As a legal consequence of this merger, all assets, liabilities, rights and obligations of Esso Standard Oil Co. will be in said Humble Oil & Refining Co. It has been reported that an operating division of Humble, to be known as Esso Standard, will be created.



George L. Bruggemeier

Named Chief Engineer

► George L. Bruggemeier has been named chief engineer for the Firestone Tire & Rubber Co., Akron, Ohio, succeeding W. K. Adkins, who has retired after nearly 41 years with the company. The company has also named S. T. Wepsic and D. E. Engle as assistant chief engineers. Mr. Bruggemeier, with Firestone since 1924, has served in various engineering capacities in the company's domestic and foreign plants. He was named assistant chief engineer in 1956. Mr. Wepsic joined Firestone's engineering division in 1936 and has been associated with the company's synthetic rubber, petrochemical and plastics operations. Mr. Engle started with the rubber firm 24 years ago and served as plant engineer at Firestone's Memphis, Tenn., plant for 10 years.

Cooper Tire Offers Stock

► Cooper Tire & Rubber Co., Findlay, Ohio, has offered for public sale 100,000 shares of common stock at $38 per share. The offering is being underwritten by the investment firms of Paine, Webber, Jackson & Curtis and Prescott, Shepard & Co. According to the company, the proceeds from this stock offering will be used to modernize and expand its facilities. The company produces tires and tubes at its plants in Findlay and Clarksdale, Miss. At present, Cooper Tire's manufacturing capacity is 8,500 tires and 8,500 tubes a day, and the company expects to raise the tire-making capacity to 10,000 a day by June 1960. Tube-making capacity will remain the same.

General Aniline Moves Offices

► General Aniline & Film Corp. has announced the removal of its home office in New York City to larger quarters in the new Time and Life Building located at 111 West 50th St. The home office will occupy the 44th floor of the Time and Life Building, the latest addition to Rockefeller Center.

Tire-Oil Deals Criticized

► Speaking before a House Small Business Subcommittee, George J. Burger, vice-president of the National Federation of Independent Business, stated that sales deals between major rubber and oil companies must be broken up. He predicted that continued inaction by the federal government will stifle "free enterprise" in tire sales, virtually close small tire producers and give the petroleum industry "domination and control" over the rubber tire industry. Rubber firms pay commissions of 7½ to 10 per cent to oil companies under agreements to service tire, battery and accessory needs of filling stations, Mr. Burger said.

Other witnesses alleged coercion of gasoline station dealers by oil companies and promised to supply names and dates at a later date. The assembled lobbyists and industry representatives were told that the committee would make appropriate recommendations. A Federal Trade Commission examiner recently found three oil firms guilty of coercing station operators. Dismissing charges against three tire firms, Goodyear, Goodrich and Firestone, he ruled that there was no evidence to show they aided the oil firms in the coercive practices.

Accused of Economic Piracy

► Crawford Parker, lieutenant governor of the State of Indiana, has called a 1955 New Mexico law which enables cities in New Mexico to sell bonds to buy, but not operate, industries that will provide new employment, a "nationwide raiding policy." Mr. Parker made his statement after the city of Deming, N. M., bought the Auburn Rubber Co. of Auburn, Ind. In acquiring the rubber company, Deming issued $4.5 million worth of bonds to buy the assets of the company and to build a new plant for it in Deming. The city sold the bonds to the International Teamsters Union pension fund. To operate the plant, which is scheduled for completion in February 1960, the city plans to lease it to a New Mexico corporation of the same name, Auburn Rubber. It is reported that some of the company's management and skilled workers will move to Deming from Auburn, Ind.

Soviets Irradiate Polymers

► Soviet Embassy, London, England, has reported in its publication *Soviet News* that Soviet scientists have made organic semiconductors. The researchers, working at the USSR Academy of Sciences' Institute of Oil-Chemical Synthesis, have made polyacrylonitrile and polyacrylonitrile-siloxane copolymers semiconductive by irradiating them with ionizing radiation of 4.5 million roentgens, the Embassy states.

H. C. Bugbee, president of the Natural Rubber Bureau, speaks to the Philadelphia Rubber Group on future developments. Other panelists are H. E. Railsback (Phillips) and, on the right, H. R. Nebeker (Shell Chemical).

Philadelphia Group Discusses Future of Natural and Synthetic Natural Rubbers

► The "Future of Natural and Synthetic Natural Rubbers" was theme of a panel discussion sponsored by the Philadelphia Rubber Group at the Poor Richard Club, Philadelphia, Penna., on January 22. About 250 persons listened to papers on "*Cis*-4 Polybutadiene" by Henry Railsback (Phillips Petroleum), "*Cis*-Polyisoprene" by H. R. Nebeker (Shell Chemical) and "Natural Rubber" by H. C. Bugbee, president of the Natural Rubber Bureau. Moderator of the discussion was Merrill Galloway (H. K. Porter).

The technical session was followed by a dinner addressed by Charles ("Chuck") Bednarik, star of the Philadelphia Eagles, who recounted his experiences in professional football. The meeting also marked the appearance of the first issue of "P.R.G. News," an occasional newsletter for Group members edited by Kenneth E. Chester (C. P. Hall).

Plans were announced for a possible joint meeting with the New York and Connecticut Rubber Groups to be held in New York City in the spring of 1961. A liaison committee from Philadelphia, composed of Ralph Graff (Du Pont), Henry Remsberg (Carlisle) and K. E. Chester, is conducting negotiations with similar committees from the other two groups. Also introduced at the meeting were the following committee chairmen for 1960: *Publicity*, K. E. Chester, *Fall Dance*, Bernard Van Arkel (Walker Brothers) and *Educational*, Richard Garrett (Armstrong).

H. F. Smith (Armstrong) heads a committee planning events for Past Chairmen's Nite to be held in conjunction with the April 29 technical meeting. The Group Historian, J. B. Johnson (Linear Inc.), is helping to arrange this program. William Macomber (U.S. Rubber) is in charge of a committee preparing a new Rubber Group directory scheduled for publication in 1961. The committee directing activities at the August 9 Golf Outing is being steered by H. F. Smith (Naugatuck) *Prizes*, and James Jones (St. Joseph's Lead) *Starting Times*.

Discusses Polybutadiene

Mr. Railsback, who spoke at the afternoon technical session on "*Cis*-4 Polybutadiene," is manager of research compounding in the Synthetic Rubber Branch of Phillips Chemical Co., Akron, Ohio. He summarized the physical properties of polybutadiene, emphasizing its low hysteresis and excellent abrasion resistance, and then suggested some measures which could avoid the difficulties of processing the material in conventional equipment. Blending it with natural rubber, he said, obviated nearly all compounding problems and produced a blend well suited to the demands of heavy truck tire treads.

Performance tests of 10:00x20 tires showed a treadwear rating of 105 for 50:50 blend treads compared with 100 for natural rubber treads on identical carcasses. Average running temperature for the former was only 201° F. against 208.5° F. for pure natural rubber treads. Other tests using styrene rubber 1500 treads as a control have yielded ratings as high as 130 for the 50:50 blends of polybutadiene. The equivalent ratings for factory-built passenger tires has been 125.

The compounding recipe for conventional tread blends calls for: 50 parts of polybutadiene; 50 No. 1 Smoked Sheet; 50 Philblack 0; 3 zinc oxide; 3 stearic acid; 1 antioxidant; 5 resin 731; 5 Philrich 5; 2 sulfur, and 0.6 accelerator. A high black recipe that ensures smoother stock is comprised of: 100 rubber; 60 Philblack; 0.5 zinc oxide; 1 antioxidant; 5 resin 731; 5 Philrich 5; 5 pine tar; 1.75 sulfur, and 1 accelerator. The stock from this recipe has a Mooney viscosity of 47, 19-minute scorch at 280° F., and these extrusion properties with a Garvey die at 250° F. —37 m/min., 67 av. cm min., fair millbanding and a rating of 11 for edges, surfaces and corners (with 12 indicating a perfect rating).

The characteristics of vulcanized stocks included these data: 300 per cent modulus (psi) of 1200, tensile (psi) 2700, 200° F. tensile (psi) 1750, elongation 560 per cent, heat buildup 60° F., Yerzeley resilience 67 per cent, Shore A hardness 62, and flex life in M flexures 2. Stress-strain data show that polybutadiene tensile strength increases and heat buildup decreases when natural rubber is added. Such blending also decreases modulus while heightening abrasion resistance. In short, the properties of *Cis*-4 polybutadiene are essentially the same, except for substantially lower modulus, as natural rubber at the same level of cross-linking.

During the question period, Mr. Railsback estimated present production of the material at 200,000 lb. per month by Phillips, with a sizable increase expected when a new plant under construction is completed. The future, he added, should also see a decrease in the current 35c a pound price.

Mr. Nebeker, the speaker on "*Cis* Polyisoprene," is engaged in product development for the Synthetic Rubber Division of Shell Chemical Corp., Torrance, Calif. He illustrated his talk with samples illustrating the light color of the polymer and its potentialities for exact detailing in molded goods. When blended with neoprene, the polyisoprene was used in electrical connectors; with natural rubber, examples were gaskets, syringes, bumper guards, swim fins and typewriter guards. He pointed out that distribution had so far been restricted to processors for developmental purposes in order to obtain service data.

Raw Polymer Properties

The typical properties of the raw polymer showed its structural purity, low ash content (0.5 per cent), 1 per cent (W) stearic acid, intrinsic viscosity of 7.0 dl/g, Mooney viscosity of 57, 0.92 gm/ml density at 77° F. (approaching that of natural rubber), and an average mole weight of 2,750,000. The modulus is substantially lower than that of natural rubber. A disadvantage, too, is the material's lack of raw green strength, limiting the elevation of its temperature. This lack does bring an incidental gain, however, in the greater

fluid mold flow of polyisoprene which permits finer detailing than with natural.

When used in tread stock formulations, the pure material exhibits tensile properties close to those of Hevea. Heat buildup and resilience are also virtually the same, but tear strength is slightly lower at 212° F. and much lower at room temperature. Still using natural rubber as a standard, polyisoprene's second major disadvantage—its slower cure rate—becomes apparent. Data on tensile properties versus SRF and medium thermal black show a drop in tensile, characteristic of less reinforcing fillers. The color stability of white stock vulcanizates has been good, with a high retention of per cent reflectance upon ultraviolet exposure.

Mr. Nebeker predicted full-scale commercial availability of polyisoprene in late 1960, when Shell's 20,000 ton per year plant goes on stream. The 300,000 pounds a month currently being produced constitute a limited supply selling at about 30c per pound.

Natural Rubber Boom

Mr. Bugbee, president of the Natural Rubber Bureau, Washington, D. C., estimated a rise in world rubber consumption from today's 3.6 million to 4.5 million tons in five years. He pointed out that the natural rubber industry sold some 70,000 tons more than the 2 million tons it produced in 1959. By 1965, he predicted, the industry will have raised production to 2.35 million tons and sell all of it. These figures will bear out the sales trend that began in 1954, when nearly all the natural rubber grown has been used in the U.S., and the world.

The anticipated average for total new rubber consumption during the next five years is expected to rise only 3 per cent, because of this country's record absorption of rubber in the motor vehicle market reaching a saturation point. Non-transport uses are, however, due to maintain the growth rate of the past seven years. The U.K. growth figure of 1.3 in total new rubber is expected to climb to 4 per cent. Improved economy, increased domestic demand, more cars and the lessening fear of nationalization are contributing factors. French and German percentages of increase are forecast to level off.

The consumption shift in favor of synthetic rubber is not anticipated to change greatly because of technological reasons. The Soviet Seven Year Plan goal of 1½ million tons is thought to have been too unrealistic, with 1.2 million a more likely figure for 1965. Synthetic rubber is expected to get the major share of the world market by that time. The similarly optimistic outlook for natural rubber, Mr. Bugbee concluded, is due in no small measure to research—the tripling of tree yields, development of plastic-like derivatives and production of rubbers maintaining qualities at extremely high and low temperatures.

Retires from U. S. Rubber

► Robert D. Gartrell, a pioneer in mechanical rubber goods research, has retired after 43 years of service with the U. S. Rubber Co., 28 of which were in the rubber company's division development laboratories in Passaic, N. J. The holder of patents in several fields, Mr. Gartrell perfected the Ustex-nylon conveyor belt introduced by U. S. Rubber in 1947 and holds patents in the printing and textile materials fields, grinding wheels, and an indoor rifle target developed for an arms company. Born in Atlanta, Ga., Mr. Gartrell attended Atlanta's Technological High School and later, entered the Georgia School of Technology, where he received a B. S. degree in chemistry in 1916.

Following a four-month position with a local coke company, Mr. Gartrell went to Canada and after eight months at a Montreal firm, was appointed research chemist for the Dominion Rubber Co., Canadian subsidiary of U. S. Rubber. He rose to the position of director of development before returning to the United States in 1931 for a one-year assignment at the parent company's Passaic plant. Named manager of the Passaic plant's Development Department the same year, he remained at that facility. By 1949, Mr. Gartrell was development manager for the Mechanical Goods Division, continuing in that position until 1958, when he relinquished the post in order to devote more time to his own research before retiring. He is a member of the American Chemical Society, the Society of the Chemical Industry in London and the New York Rubber Group, of which he is past chairman.

Robert D. Gartrell

Joins Columbian Carbon

► Dr. Charles A. Stokes has joined the Columbian Carbon Co., New York, N. Y., as general manager of research and development of the company's Carbon Black and Pigment Division. Dr. Stokes, who has had extensive experience in the fields of carbon black and petrochemical research, was formerly associated with the Texas Butadiene and Chemical Corp. He is a chemical engineering graduate of the University of Florida and the Massachusetts Institute of Technology, where he served on the teaching staff. He is a member of the American Chemical Society and the American Institute of Chemical Engineers. Dr. Stokes will have his headquarters at the Columbian Research Laboratories in Princeton, N. J.

Dayton Offers Debentures

► Dayton Rubber Co., Dayton, Ohio, has filed a registration statement with the Securities and Exchange Commission covering a proposed public offering of $7.5 million of convertible subordinated debentures, due in 1980. According to the company, the proceeds from the issue will be used for a variety of purposes, including expansion and the reduction of loans. The banking firm of Lehman Brothers will manage the underwriting syndicate.

Raise Funds to Move Rubber Firm

► A $150,000 campaign has been undertaken to transfer a Huntington, West Va., rubber concern to Radford, Va. Money from the drive, which is now more than half way to its goal, is to be used for equipment and operating expenses of the Graflo Rubber Co. in its projected move. The city already has promised to construct a building for lease to the firm. Of a total of $75,000, which has already been collected, $10,000 has been contributed by the American National Rubber Co. of Huntington, which expects to move to Radford at the same time as with the Graflo firm, setting up business next door. Graffo manufactures large sheets of of rubber and American National converts these sheets into manufactured articles. Officials said Graflo is expected to employ between 40 and 50 persons when in full operation.

Witco Chemical Adds to Board

► Witco Chemical Co., Inc., New York, N. Y., has announced the election of Cuthbert C. Hallet as a director. Mr. Hallett is managing director of the Witco Chemical Co., Ltd., an English subsidiary. The parent company also announced the election of Robert Shacklady as joint managing director of the English concern.

Joins Natural Rubber Bureau

► Natural Rubber Bureau, Washington, D. C., has announced that Ralph F. Wolf, formerly manager of compounding research at the Columbia-Southern Chemical Corp., Barberton, Ohio, has joined its executive staff as director of technical service. H. C. Bugbee, president of the Natural Rubber Bureau, noted that Mr. Wolf's appointment "reflected the broad expansion in research now being effected by the natural rubber industry."

Rubber growers of Malaya recently announced a 50 per cent increase in funds allocated for research and development. These funds will be used to expand the industry's agricultural research activities at the Rubber Research Institute in Kuala Lumpur, Malaya, and the fundamental and applied work being carried on by the British Rubber Producer's Research Association at Welwyn Garden City just outside London. "We have been doing excellent work at our laboratories abroad," Mr. Bugbee said, "and have long needed someone here who could pass on to the American manufacturing industry knowledge of what we are accomplishing. Superior Processing rubber is a good example. This has had some recognition and use in the United States, but not near that deserved by the efficiency it adds to extruding and calendering operations.

"Our new Technical Service Department," Mr. Bugbee added, "will act as the catalyst between the advances developed by our laboratories and the effective application of these in Natural usage here. We are delighted to have head up this strategically important service someone as obviously qualified as Ralph Wolf."

Mr. Wolfe who took his B. Ch. E. degree at Catholic University in 1932, has spent his entire professional career in rubber technology. When he left B. F. Goodrich in 1940, he was in charge of all mechanical goods compounding as assistant technical director of Goodrich's Kitchener, Ont., plant. He spent several of the war years in Washington as assistant chief of the Synthetic Rubber Section, Office of

Ralph F. Wolf

Production Management; chief of the Synthetic Rubber Allocation Section, Rubber Branch, War Production Board; and consultant on butyl rubber, Office of Rubber Director. In addition to his last position with Columbia-Southern, he has also been manager of synthetic rubber compounding research for the Standard Oil Development Co.; assistant factory manager for the Polson Rubber Co.; and technical director of Harwick Standard Chemical Co.

Since 1930, Mr. Wolf has been a consistent contributor to such publications as RUBBER AGE, *Rubber World*, *Scientific Monthly* and *Rubber Journal of London*. He has written two books, "India Rubber Man, the Story of Charles Goodyear," and with H. Wolf as co-author "Rubber, A Story of Glory and Greed." In addition, he has contributed chapters on rubber to the "Book of Knowledge Annual" and "Introduction to Rubber Technology."

Mr. Wolf will spend February at the Natural Rubber laboratories in England, familiarizing himself with the latest advances in natural rubber technology. When he returns in March, he will headquarter in Akron, Ohio. He is expected to build a staff for coverage in other manufacturing sections of the country during the year.

Lee Rubber Answers FTC Charges

► Lee Rubber & Tire Corp., Conshohocken, Penna., has issued a denial to the charges made by the Federal Trade Commission that it has been using deceptive brand names on its tires. The FTC's complaint, made on September 24, 1959, claimed that Lee's Ultra Deluxe and Advanced Super Deluxe tires are not of equal quality, such as premium or first line as implied both by the names themselves and Lee's advertising. According to the complaint, the tires are premium and second line, respectively. Lee has denied representing that the two tire categories are equal in quality. The company stated that a customer does not ordinarily buy respondent's tires from advertising alone, but from a dealer at the dealer's place of business where ordinarily a stock of Ultra Deluxe tires are displayed for sale so that the customer can ordinarily be expected to be aware of this superior brand made by respondent.

Lee also denied the FTC's allegation that it lowered the quality of its Advanced Super Deluxe and Regular Deluxe tires without revealing this fact in advertising. Lee further stated that it knows of no case of any person having been misled by its tire brand names, and that it has received no complaints with respect to its tire brand names from customer, dealer, competitor or other person except the complaint of the Federal Trade Commission.

Carlisle Buying Wire Company

► The Carlisle Corp., Carlisle, Penna., has announced that it is acquiring the International Wire Products Corp. and its affiliate, Simplex Tinning and Wire Products Corp. The company reports that the acquisitions would materially increase Carlisle's stake in the growing area of electronic miniaturization. The multi-million dollar transaction involved an undisclosed amount of notes and stock. According to Carlisle, the two new companies will add about $3 million a year to its sales, which in 1959 were $22 million. The companies will be operated as subsidiaries of Carlisle, which now has seven plants. The company also announced that Anthony Rissuto will continue to serve as president of International and Simplex, and Irving Landes will continue as executive vice-president and treasurer.

Swaggart Named Vice-President

► John P. Swaggart has been elected vice-president of the Bullard Clark Co., Danielson, Conn., and in addition, he will continue as technical director of the Jacobs Rubber Division. Mr. Swaggart received his B. S. degree from the University of Denver in 1932. His first industry employment was in 1926 for the Gates Rubber Co., Denver, Colo., as a laboratory technician. Later, he served as a development engineer for molded rubber products and applied research problems. In 1952, Mr. Swaggart joined Jacobs Rubber Division of Bullard Clark as chief chemist and in 1955, he became technical director.

Plans New Delhi Tire Facility

► Plans for a $12 million tire and tube manufacturing project, 20 miles south of New Delhi, India, have been announced by the Goodyear Tire & Rubber Co., Akron, Ohio. To be located on a 50 acre site on the Agra road, construction of the facility will begin immediately with completion scheduled for early 1961. The plant will be equipped with the most modern tire manufacturing machinery for the production of passenger, truck and farm tires and tubes. The new plant of the Goodyear Tire & Rubber Co. of India, Ltd., will employ approximately 900 workers, virtually all Indians.

Hewitt-Robins Names Gardner

► Hewitt-Robins, Inc., Stamford, Conn., has announced the appointment of Ellis B. Gardner as its executive vice-president. Mr. Gardner joined Hewitt-Robins in 1946 and has served as controller, vice-president and treasurer. Since 1955, he has headed the Foam Products Division.

CMRA Examines Consumer Demand

► Chemical Market Research Association, scheduled to meet on February 17 and 18 at the Lord Baltimore Hotel in Baltimore, Md., was to have covered the area of consumer market research as an aid to chemical market research. The topic was chosen because it is believed that the chemical industry must critically examine consumer preferences and markets as guides to its course of action on its products. It is also believed that because the bulk of these products are several steps removed from the ultimate consumer, the industry often fails to recognize the effect of consumer demand.

Technical sessions were to have been held on Thursday, February 18. The morning program included the following papers: "An Industrial Company Looks at the Consumer Products Field," by A. S. Johnson (Union Carbide); "Understanding the Psychology of Consumer Acceptance," by Dilman M. K. Smith (Opinion Research); and "Consumer Personality and New Product Development in 1960," by Ernest Dichter (Institute for Motivational Research). The luncheon speaker, Clark L. Wilson (Batten, Barton, Durstine & Osborn), was to have discussed "Carry-Over from Consumer to Industrial Market Research."

During the afternoon session, the following papers were to have been presented: "Building the Refrigerant Market Through Consumer Research," by Ralph A. Crane (DuPont); "Giving Consumer Research a Catalyst for Big Pay-Off," by Ralph Fields (Reynolds Metals); and "The Ford Falcon—A Case Study in Predicting Consumer Acceptance for Future Products," by George Brown (Ford Motor).

Henley Introduces Activator R

► Henley & Co., Inc., New York, N. Y., has introduced the new Auxiliary Agent-Activator R for use in compounds incorporating silica fillers. When using silica fillers, some difficulties may arise as the filler cannot easily be incorporated and the compounds incline to tighten and scorch. Auxiliary Agent-Activator R is said to considerably reduce the deformation hardness of the raw mixes, without having any influence on the shore hardness of the final product, and also to prolong the Mooney/scorch line. Even susceptible compounds can be processed without danger of scorching. According to Henley, the speed of vulcanization is not changed by the addition of Activator R. The vulcanizate, however, is influenced favorably by the dispersing effect of the material. Transparent compounds do not lose their transparency and additions of 8 to 12 per cent, calculated on the contents of filler, have shown excellent results, the company states.

Frank J. Raba

Named by American Cyanamid

► American Cyanamid Co., New York, N. Y., has announced the appointment of Frank J. Raba as a sales representative for its Rubber Chemicals Department. His headquarters will be at the company's Bound Brook, N. J., sales office. Mr. Raba is a graduate of Lafayette College. Prior to his joining American Cyanamid, he was with the General Cable Corp., and Triangle Conduit and Cable Co. Mr. Raba is a member of the Rubber Division, ACS, the New York Rubber Group and the Philadelphia Rubber Group.

Discusses Equipment Leasing

► Robert Sheridan, president of Nationwide Leasing Co., Chicago, Ill., has disclosed that long-term leasing of production equipment by rubber manufacturing firms during 1959 spurted ahead, reaching a total of $5.4 million worth of equipment on lease, a gain of 80 per cent over 1958. Mr. Sheridan predicted that equipment leasing in the rubber industry would double in 1960 because of three factors: (1) More equipment manufacturers are using leasing as a sales tool to move their products; (2) More companies will lease their equipment to avoid the pinch of tight money; and (3) More companies will be affected by the increasing technological progress which is speeding up obsolescence of machinery.

Elected Reeves Vice-President

► Edward C. Hemes has been elected vice-president of Reeves Brothers, Inc., New York, N. Y. Mr. Hemes, a well known figure in the gas utility field, once served as superintendent of measurement with Milwaukee Gas Light Co. Later, he became executive vice-president of Vulcan Rubber Products, Inc., which pioneered synthetic diaphragms for gas meters and regulators. Mr. Hemes joined Reeves Brothers in 1953, when Vulcan Rubber Products was acquired by that company.

Seiberling Predicts Growth

► J. P. Seiberling, president of the Seiberling Rubber Co., Akron, Ohio, recently predicted that the new year will become the nation's first "half trillion dollar" year in business. By the end of 1960, he said, Americans should be producing goods and services at a $520 billion annual rate, about $35 billion above the present pace. The tire industry is expected to break its sales records. "In 1960, we expect the production of truck and passenger tires to exceed 118 million units, surpassing 1959 by about 8 per cent," Mr. Seiberling said.

Production of passenger tires for the replacement market is expected to rise to at least 68 million units, up about 4 per cent over 1959. Mr. Seiberling sees a slight dip in replacement tires for trucks because of greater use of recapping and longer-wearing tires. He said the sale of tire retreading materials is a "very bright spot." According to Mr. Seiberling, two main factors contribute to this picture: anticipated high sales of new and used autos plus an all-time high in the number of used cars on the road. Mr. Seiberling predicted "tremendous growth" in automotive and tire industries through the entire 1960s.

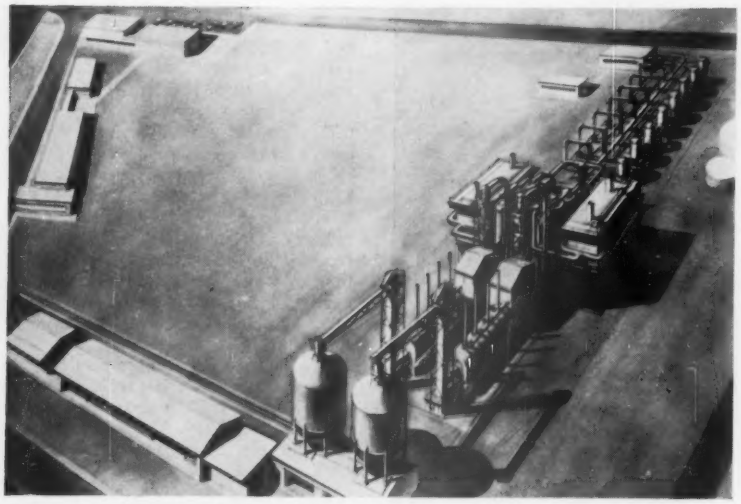
Reclaimers Elect 1960 Officers

► Rubber Reclaimers Association, New York, N. Y., has announced that Henry L. Dixon, general manager of Adhesives Products for the B. F. Goodrich Co., has been named president of the association for 1960. Vice-president is Donald L. McCollum of the Naugatuck Chemical Division of the U. S. Rubber Co. Charles T. Jansen, advertising sales manager of *Adhesives Age* and RUBBER AGE, industry trade publications, will serve as secretary-treasurer.

The association has also announced that T. H. Fitzgerald of Naugatuck Chemicals, retiring president of the association, has been named to the executive committee where he will serve as chairman. C. H. Peterson, president of U. S. Reclaiming Co., has again been named chairman of the association's education committee. This committee works closely with local rubber groups to provide speakers for meetings and lecturers for the courses in rubber technology now being conducted by various rubber groups.

Named Research Vice-President

► Dr. Rush F. McLeary, general manager of the Research and Development Department, has been elected vice-president, research and development of the Jefferson Chemical Co., Houston, Texas, jointly owned subsidiary of the American Cyanamid Co. and Texaco, Inc.



Plans $5 Million French Plant

► United Carbon Co., New York, N. Y., has announced plans to form a French subsidiary and to build a $5 million carbon black plant near Rouen in north central France. The new plant is expected to be completed in 1961 and will have an initial rated capacity of 50 million pounds annually. According to a company official, the choice of plant location was made after consultation with French government officials, major users, and long time customers of the firm's Kosmos and Dixie reinforcing carbon blacks.

There is, at present, a concentration of rubber end product manufacturing facilities in northern and central France and further industry expansion in those areas is anticipated. Port Jerome, which is about ten miles north of Rouen, is said to offer good raw material supplies. Current plans are to first produce the higher grades of reinforcing black such as FEF, HAF, ISAF, and SAF.

Silver Named Chief Chemist

► Hyman Silver has been appointed chief chemist of Ace Rubber Products, Inc., Akron, Ohio. Mr. Silver formerly served at the laboratory of the Midwest Rubber Reclaiming Co., Barberton, Ohio, and prior to that, he was chemist for the development of industrial products at the American Hard Rubber Co., Akron, Ohio. He has also served as chief chemist for the city of Canton, Ohio. A graduate chemist from Ohio State University, Mr. Silver will continue the program of research, quality control and product development formerly headed by Harold Reuben, who was recently promoted to factory and technical manager of Ace Rubber.

Schulman Opens Texas Plant

► A. Schulman, Inc., Akron, Ohio, has announced that its new reprocessing plant for plastics has been opened in Orange, Texas. The plant is located on "Chemical Row" adjacent to many petrochemical operations specializing in the production of various plastics. The company also has announced that Paul Wysynski, assistant plant superintendent at its Akron plant, has been named manager of the new facility. The Texas plant employs 50 persons.

Enjay Increases Butyl Capacity

► Enjay Co., Inc., New York, N. Y., has undertaken a program to modify and expand the Baton Rouge, La., refinery of the Esso Standard Oil Co. in order to increase annual production of Enjay butyl rubber by 38,000 long tons. The modifications are expected to provide increased operating efficiency and improved quality control along with additional capacity. Total capital cost of improvements now in various stages of design and construction will be $16 million. Of the 38,000 long tons per year of new plant capacity at Baton Rouge, 20,000 long tons will become available in mid-1960, followed by another 18,000 tons during the second quarter of 1961.

Goodyear Expands Vitafilm

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced a 50 per cent expansion in Vitafilm production facilities. Expansion is now underway at Akron Plant B of the subsidiary Goodyear Aircraft Corp., the site of the parent company's manufacturing facilities for the heavy-duty material. A multi-million dollar program which doubles the company's vinyl flooring capacity was announced recently.

Predicts Rubber Industry Growth

► In a year-end statement, Harvey S. Firestone, Jr., chairman and chief executive officer of the Firestone Tire & Rubber Co., Akron, Ohio, said the rubber industry is on the threshold of a 10 year period that promises unprecedented growth. Citing increasing demand for company products, Mr. Firestone said he sees 1960 "as the greatest year in the history of our progressive industry. The general upward trend which was briefly interrupted in 1958, was back in stride in 1959 and is pointed toward greater heights."

Mr. Firestone cited six factors upon which he is basing his forecast including the great promise existing in the general economy; the rapidly increasing number of motor vehicles in use; the rapid growth of foreign markets; improved technology within the rubber industry; expansion of existing production facilities; and diversification into broadened fields of activity. He stressed that the auto industry promises almost phenomenal growth in the 1960s and that this will have a vital influence on the rubber companies. He noted also that the technology of the industry is presently at a very high level and is progressing rapidly.

According to Mr. Firestone, the company plans to carry out extensive expansion in the 1960s and also to increase its progress in other rubberlike materials, textiles, metals and chemicals. A further increase in the consumption of rubber in the United States in 1960 over record 1959 is foreseen. Total tire demand is expected to rise to about 127,000,000 units, an increase of almost 10 per cent over 1959.

Seiberling Building New Plant

► Seiberling Rubber Co., Akron, Ohio, has announced that it will establish a new plant in Bateville, Ark., as part of its current expansion program. Initially the plant will employ about 100 persons and will produce additional shoe products and other rubber goods, now being produced at full capacity at the firm's plants in Barberton and Carey, Ohio. According to Seiberling, plans call for a building of 100,000 square feet on a site of 20 acres or more, with construction to begin this Spring.

Smith Named Manager

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced that Harry D. Smith has been named manager of international synthetic rubber projects for the company. He succeeds the late George R. Lyon. A graduate of Rice Institute. Mr. Smith joined Goodyear in 1943 and served at the company's Houston, Texas, plant as a chemical engineer.

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General Aniline Realignment

► The Commercial Development Department of the Dyestuff and Chemical Division of General Aniline & Film Corp., New York, N. Y., has been divided into two sections. One section will handle market development while the other will deal with business research. Dr. Cecil M. Knowles has been appointed manager of market development, with both the product development and sales development groups reporting to him, and Dr. Albert Bloom has been named manager of business research. The company has also appointed Dr. William E. Duggins as supervisor of product development and Francis J. Prescott as supervisor of sales development.

Dr. Knowles joined General Aniline in 1943 as a research chemist. He has held a number of positions in the Research and Marketing Departments, serving most recently as administrative assistant to the general manager of the Dyestuff and Chemical Division. Dr. Bloom has been with the company since 1945 and has been in the Commercial Development Department as manager of planning since 1954. Dr. Duggins joined the company in the Linden Process Development Department in 1949, and in 1952 he transferred to the Commercial Development Department as product development engineer. Mr. Prescott has been a product development engineer in the Commercial Development Department since 1954.

Industrial Rayon Plans Merger

► The board of directors of the Industrial Rayon Corp., Cleveland, Ohio, have approved a plan for the combination of Industrial Rayon and Texas Butadiene & Chemical Corp., Houston, Texas. The proposal is subject to the completion of examinations and verifications of both companies and to the approval of stockholders of Industrial Rayon. The combination will take the form of an acquisition of Texas Butadiene & Chemical by Industrial Rayon for approximately 1,675,000 shares of common stock of Industrial Rayon, which has 1,851,255 shares of stock presently outstanding. Hayden B. Kline, president of Industrial Rayon, will become chairman of the board of directors and John Fennebresque, president of Texas Butadiene & Chemical, will become president and chief executive officer of the combined company. A meeting of stockholders of Industrial Rayon will be called early this year.

Ogden Appointed to New Post

► International Latex Corp., New York, N. Y. has appointed Gordon A. Ogden to the position of executive vice-president of the International Division. Mr. Ogden joined the organization in 1948, was made a vice-president in 1951 and has been in charge of the International Division for the last four years.

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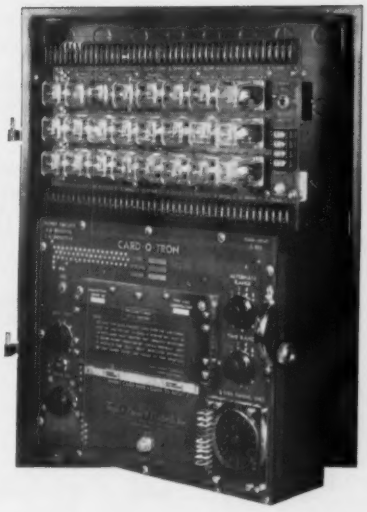

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With this remarkable new instrument you—

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- save repeated and costly trial and error settings.
- insure absolute uniformity of process.
- save operator time.

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Names in the News

J. A. Dixon, director and general marketing manager of Courtaulds (Canada) Ltd., has been elected chairman of the promotion advisory committee of Tyrex, Inc.

George E. Shepherd has been appointed sales manager of the New England district for the Silicone Products Department of General Electric Co.

T. W. Brasfield has been appointed director of marketing for Velsicol Chemical Corp.

Boutwell H. Foster has retired after 42 years of service with U.S. Rubber Co.

Dr. Leland G. Cole, formerly chief research chemist for Consolidated Electrodynamics Corp., has been appointed vice-president, research for Beckman Instruments, Inc.

John L. Collyer, chairman of the board of B.F. Goodrich Co., has been named Cornell University Alumnus of the Year.

David X. Klein, previously technical director of Heyden Chemical Division, Heyden Newport Chemical Corp., has been appointed a divisional vice-president.

William J. Fritton has been elected executive vice-president of U.S. Rubber Reclaiming Co.

Max F. Moyer has retired after 33 years of service with Goodyear Tire & Rubber Co.

Ralph W. Shrum, previously with Cat's Paw-Holtite Rubber, has joined Genruco Processing Co., as chief chemist.

Chester W. Christensen has been named product director for rubber chemicals at the Organic Chemicals Division of Monsanto Chemical Co.

Douglas G. Rodenburg has been named to head technical service on rubber chemicals for Naugatuck Chemicals, a division of Dominion Rubber Co., Ltd.

Clarence H. Mingle, previously director of marketing, has been named executive vice-president of Gates Rubber Co.

Edward R. Bartley has been named by B. F. Goodrich Co. to the newly-created post of manager of marketing.

Richard H. Hugger has been appointed senior department manager of the research center of U.S. Rubber Co.

Charles W. Haines has been appointed assistant to the chairman of the board of directors of New York Rubber Corp.

George Hessney has been named production manager of the Hose Departments of B. F. Goodrich Industrial Products Co., succeeding **Herman Resseger,** who has retired.

Dr. William A. Hamor, senior director of research at Mellon Institute, has retired after 45 years of service.

A. Lynam Satterhwaite, manager of the Control Division, Elastomer Chemicals Department, E. I. du Pont de Nemours & Co., has retired after 37 years of service.

J. L. Whitney, previously with B. F. Goodrich Co., has joined the Marbon Chemical Division of Borg-Warner Corp. as a sales-service engineer.

Arthur Thomas, Jr., has been appointed commodity sales manager of Kralastic materials for the Naugatuck Chemical Division of U. S. Rubber Co., while **John M. Bolt** has been named sales manager of the company's Memphis, Tenn., district.

Dr. Patrick K. Gallagher has joined the technical staff of Bell Telephone Laboratories.

Gordon A. Stewart has been named a sales representative for the Building Materials Division of General Tire & Rubber Co.

H. R. Bishop has been appointed manager of the Middle Atlantic and Southern sales districts for the Polymer Chemical Division of W. R. Grace & Co. He succeeds **Warren E. Peterson,** who has been named product manager, electrical grade polymers.

Bruce W. Barnes and **L. F. McBride** have joined Columbian Carbon Co., as sales representatives for its Carbon Black and Pigment Division.

A. M. Eggeman has been named director of purchases for Witco Chemical Co., succeeding **Michael D. MacBurney,** who was appointed general manager of the firm's Product Division.

Dr. Carl T. Lenk has been named manager, chemical research, in the Contract Research Department of Wyandotte Chemicals Corp., and **David J. Craig** has been appointed manager, propellant research, in the Contract Research Department.

Robert E. Rehm

General Names Plant Manager

► General Tire & Rubber Co., Akron, Ohio, has announced the appointment of Robert E. Rehm as manager of its new tire manufacturing plant at Mayfield, Ky. The appointment is effective immediately and the $12 million facility is scheduled for completion in the Fall of 1960. Mr. Rehm, formerly production manager at General's Akron tire plant, holds a B. S. degree in mechanical engineering from the University of Akron. He joined the company in 1949 and has served in production, technical work and administration through successive positions in factory quality control, manufacturing analysis and plant management. Mr. Rehm is a member of the American Society of Mechanical Engineers.

Elected to New Post

► Pittsburgh Coke & Chemical Co., Pittsburgh, Penna., has announced the election of Putnam B. McDowell as vice-president, administration, a new position in the company. Mr. McDowell, who joined the company in 1955, will be responsible for administration of general corporate policy and for coordination of line and staff activities. He was formerly assistant to the president. Prior to joining Pittsburgh Coke, Mr. McDowell had been associated with the Scaife Co. A native of Boston, Mass., Mr. McDowell was graduated by Harvard College and the Harvard Business School, where he received an M. A. in business administration.

Ware Chemical Names Agent

► Ware Chemical Corp., Westport, Conn., has named the Chemicals and Pigments Corp., Newton, Mass., as its New England agent. Donald Lukens and William E. Walker, of Chemicals and Pigments, will handle Ware Chemical's line of pre-dispersed chemicals which are sold under the trade name, Prespersion.

DuPont Develops Improved Bag

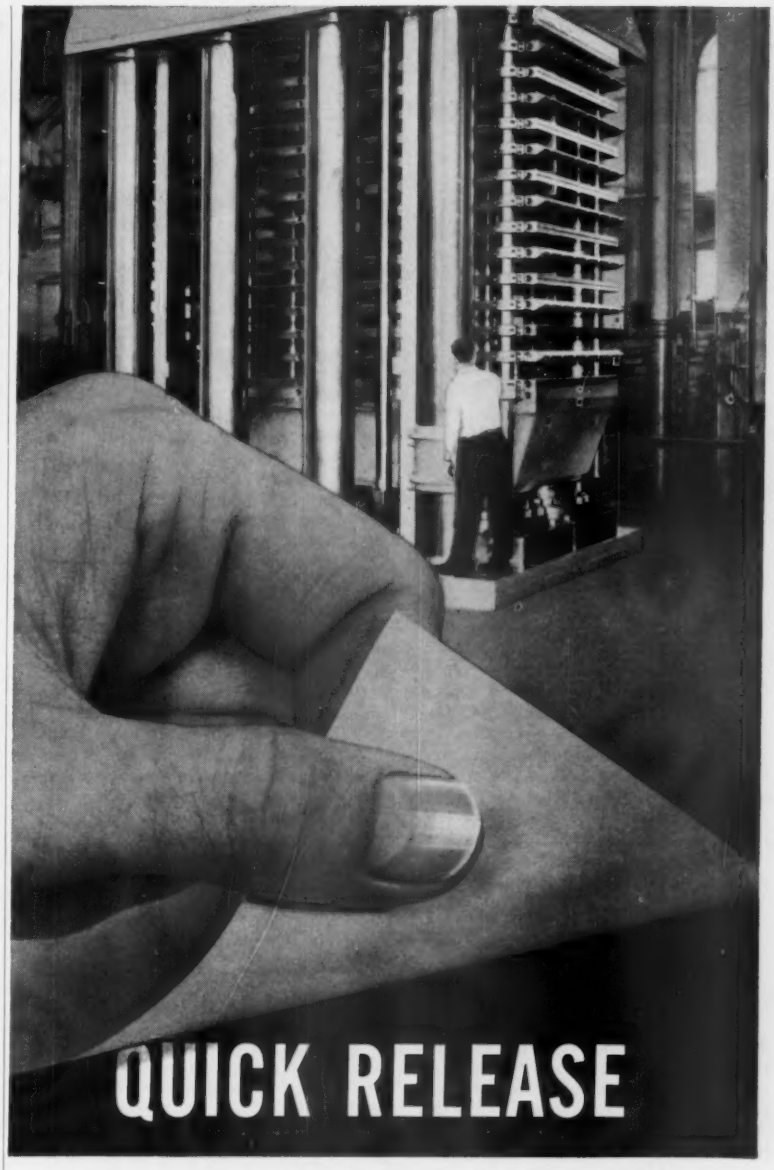
► E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has announced that its Elastomer Chemicals Department has developed a new pasted, open-mouth bag for neoprene which is reported to give better loading and handling and storage performance and allow quicker identification of type and lot number. According to the company, the outer-ply of the new bag is treated with Ludox colloidal silica to impart "no-slip" qualities and improve pallet stability. In addition, the squared ends of the container add stability and neatness to pallets, making them easier and safer to handle and facilitating double tiering. DuPont claims that the more compact shape allows use of pallet approximately two inches small in each dimension, an aids in loading and unloading by mechanical equipment. Lot numbers are readily visible on bag ends when stacked and code letters identifying neoprene types appear on ends, sides, front and back, and are color-coded for easier identification in storage, the company states.

Goodyear Introduces Tractionizing

► Goodyear Tire & Rubber Co., Akron, Ohio, has announced the introduction of a process called "tractionizing" which is being applied to its Suburbanite winter tires. According to the company, the tractionizing process consists of making thousands of small holes in the outer surface of the tire tread. The holes are reported to give a highly flexible, crepe-like quality to the top, road-contacting surface of the tread. This quality enables the tread to virtually snuggle down and embrace every small dent and bump on a snow-covered or slippery highway for traction and stopping ability, the company states. Goodyear reports that tests made on the tractionized tires at its winter testing facilities at Pine Lake, Wisc., show such results as a 25 per cent traction improvement one ice and 13 per cent more resistance to sideslip on wet pavement. The comparisons were made with tires identical except for tractionizing.

Building Concrete Pipe

► Fullerform Continuous Pipe Corp., Phoenix, Ariz., reports that it can build concrete pipe at the rate of 8 to 12 feet a minute in a newly cut ditch with the help of a rubber-and-fabric form developed with the aid of Goodyear Aircraft Corp., Akron, Ohio. According to Fullerform, the rubber-and-fabric inflatable form, made from blimp-type materials, is dropped into the ditch and a forming machine is pulled along the rounded bottom of the ditch, enveloping the inflated form. By this method, the inflated inner form is picked up so tamping devices can literally tuck concrete under it. The process eliminates joints and seams and cuts construction time and costs, the company states.



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Canadian News

► Canadian Industries Ltd., Montreal, Quebec, has announced the appointment of Frank J. Lewis as a special representative to service the Canadian rubber and oil industries. He will specialize in rubber chemicals and oil additives. Mr. Lewis, a native of Blackie, Alberta, holds a B.S. degree in mining engineering from the University of Alberta. He was employed by a number of mining firms in northern Canada prior to joining Canadian Industries in 1950.

► The Tenth Canadian High Polymer Forum will be held on September 8 to 9, 1960, at the Alpine Inn, in Ste. Marguerite, near Montreal, Quebec. The Forum is sponsored by the National Research Council of Canada in cooperation with the Chemical Institute of Canada, and is devoted to all aspects of polymer science. Dr. L. A. McLeod (Polymer Corp. Ltd.) will serve as chairman of the forum. Authors who wish to submit papers for presentation at the forum should contact the program chairman, Dr. K. E. Russell, Department of Chemistry, Queen's University, Kingston, Ontario. Titles are required by May 1, and abstracts of approximately 300 words by June 30.

► The Chemicals Division of the Aluminum Company of Canada, Ltd., has become a member of the Manufacturing Chemists' Association, Inc. The division has plants at Arvida and Wakefield in Quebec, and its principal products are caustic soda and chlorine, magnesia chemicals, alumina chemicals, sulfuric acid, fluorides and lime. The Manufacturing Chemists' Association represents more than 90 per cent of the chemical production capacity in the United States, and its membership includes 11 Canadian chemical firms.

Mirsky Joins Wyatt

► Monroe Mirsky has joined the Plastics and Rubber Division of Wyatt Industries, Inc., Houston, Texas, as chief rubber chemist. A graduate of Texas A & M College, for the past 10 years he has been chief rubber chemist for the Guiberson Corp., Dallas, Texas. Mr. Mirsky will head up a research staff, which Wyatt's announced following the purchase of the business of the Houston Rubber Co. A laboratory is being set up at its location, 3503 Chenevert St., Houston, for expansion of product research, development and quality control.

Firestone Injury Incidence Low

► Fourteen plants of the Firestone Tire & Rubber Co., Akron, Ohio, completed the first nine months of 1959 without a lost time injury, according to the company. A Firestone Safety Department report on the first three quarters of last year revealed that the Akron synthetic plant was among the first 14 with an accident freguency rate of 0.0. The accident rate of all Firestone plants of 1.4 was well below the national average of 3.5 for all operations covered in the study, the company states.

Glidden Appoints Vastrick

► Glidden Co., Cleveland, Ohio, has announced the appointment of Walter H. Vastrick to the Baltimore, Md., sales staff of its Chemicals-Pigments-Metals Division. According to the company, Mr. Vastrick's appointment is the result of the division's stepped-up marketing activities and expansion of its sales force in order to better serve the growing demand for titanium dioxide and other products of the division. Mr. Vastrick graduated from the University of Michigan in 1948 with an M. S. degree. Prior to joining Glidden, he was with St. Regis Paper Co., Allied Paper Corp., and Hawthorne Paper Co.

Form New Rubber Firm

► A new firm, called the Ferro Rubber Co., has been established at Girard, Ohio, for the production of extruded, molded, lathe cut, punched, solid and sponge rubber for the household and industrial fields. Officers of the new organization are: Ernest D. Ferro, *President;* John J. Menosky, *Production Manager;* Ralph Deemer, *Sales Manager;* and Stephen A. Palmer, *Technical Director.*

Rejects Petition to Quit URW

► National Labor Relations Board has rejected a petition by 48 maintenance employes at the American Hard Rubber Co. to get out of the United Rubber Workers Union. Dissatisfied with representation by the URW, the maintenance workers sought to set up their own union, the Independent Association of Craftsmen. They believed they could receive greater benefits if they belonged to a separate union composed of skilled tradesmen only. The maintenance workers are members of URW Local 15.

NLRB cited a number of precedents in rejecting the maintenance employes' petition, pointing out that the group in question is composed of several crafts: pipefitters, millwrights and welders. Because several skills were involved, the Board ruled, the proposed association was not an appropriate unit for bargaining purposes. It is believed that the ruling is of great significance to the entire rubber industry. Had the maintenance employes been successful in splintering off, they would have encouraged skilled tradesmen at other rubber plants to attempt similar action.

Witco Staff Changes Announced

► Organic Chemicals Division of the Witco Chemical Co., Inc., New York, N. Y., has appointed Harold B. Seligman as vice-president and general manager; Jerome Harrison as vice-president and director of marketing; and Stanley D. Shaw as midwestern sales manager. Mr. Seligman, formerly financial and administrative vice-president of the company, has been associated with Witco and its affiliate, Continental Carbon Co., since 1931. He remains at Witco headquarters in New York City. Mr. Harrison, formerly vice-president in charge of midwestern sales for the Organic Chemicals Division, joined Witco in 1925. In his new assignment, he heads up all divisional sales activities. Previously located in Chicago, his offices are now in New York City. Mr. Shaw, formerly Mr. Harrison's assistant with the title of assistant midwestern sales manager for the division, joined Witco in 1941. He remains in Chicago.

Harwood Joins University Staff

► The University of Akron, Akron, Ohio, has announced that Dr. James Harwood has joined its staff as a research associate in the Institute for Rubber Research and assistant professor of chemistry. A native of Akron, Dr. Harwood received his B.S. degree from the University of Akron, and his Ph.D. from Yale University. Dr. Harwood comes to the University from the Monsanto Research Laboratories in Dayton, Ohio. He is a member of the American Chemical Society.

Hercules To Buy Imperial Color

► Hercules Powder Co., Wilmington, Del., has announced that it will acquire Imperial Color Chemical & Paper Corp., Glens Falls, N. Y., under a tentative agreement reached by directors of both companies. According to Hercules, the acquisition is subject to the approval to a formal agreement by directors and the vote of stockholders of both companies at meetings scheduled for March. Under the proposal, the 1,019,604 outstanding shares of Imperial Color common stock would be exchanged for 509,802 shares of a new class of Hercules stock, to be designated $2.00 cumulative convertible preferred stock. The new stock issue would be subordinate to Hercules' 5 per cent preferred stock and will be non-callable for five years. The new preferred issue will carry the right to be converted into nine-tenths of a share of Hercules common for a period of 60 days after its issue, and thereafter into eight-tenths of a common share. With Hercules common stock selling for about $70 per share, this indicates a potential valuation of approximately $32 million.

Pennsalt Building Center

► Pennsalt Chemicals Corp., Philadelphia, Penna., has announced plans for the construction of a technical center to be located at King of Prussia Park, near Valley Forge, Penna. According to the company the center will ultimately represent an investment of $6 million and will permit an orderly expansion of its growing needs for technical facilities, for research, for development and technical service. Plans call for a campus-type arrangement featuring a central mall. The first building in the complex will be a two-story laboratory occupying approximately 21,000 square feet. The company reports that this building will be devoted to product development and technical service on its proprietary chemicals for the metal working industry, laundry and dry cleaning trade, food and dairy plants, as well as consumer products for the farm and home. Construction of the first building will start early this year and is expected to be completed by the end of the year.

Polyester Type Binder

► The development of a 100 per cent polyester type of binder for natural and synthetic scrap foam, which works well on either polymer or combinations of both, has been announced by the International Coatings Co., 1441 West El Segundo Blvd., Compton, Calif. Called the 2H-156 Foam Binder, the new material is said to be unique in that excellent bonding is achieved using amounts as little as five pounds to 100 pounds of scrap foam. Curing time is reported to be reduced by 50 per cent or more and drying after coring is completely eliminated.

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West Coast News

► The University of Southern California has offered several courses on rubber technology in the 1960 spring semester. Credit courses were to have begun on February 8 and non-credit courses on February 18. Courses offered include:

Chem. Eng. 442—Rubber Technology I (2 units credit). This is a lecture course on natural and synthetic rubbers, the production, testing, compounding, processing and uses. Also included are developments in the rubber industry.

Chem. Eng. 443 BL—Rubber Technology Laboratory I (2 units credit). A continuation of Chem. Eng. 443 AL, this covers unit operations of the rubber industry including compounding, mixing, extruding, curing, preparation of test samples, and testing. Theory and practice of testing methods for natural and synthetic rubbers is also included.

Chem. Eng. 528—Rubber Technology II (3 units credit). Recent developments in the rubber industry are covered in this seminar type course which includes background lectures and reports by students on recent literature.

Chem. Eng. 015B—Basic Rubber Technology (non-credit). This is a continuation of Chem. Eng. 015A, which covers natural and synthetic rubber, basic compounding, processing, curing, mold design, cements, factory engineering. This is a practical course for technical or non-technical students.

The Department of Chemistry of the University of Southern California has scheduled a series of lectures on the "Properties and Reactions of Macromolecular Systems." The series is supported by the Aerojet-General Corp., Azusa, Calif.; Products Research Co., Los Angeles, Calif.; and the Synthetic Rubber Division of Shell Chemical Corp., Torrance, Calif. The lecture schedule includes: February 18: "Generalized Rate Theory in Macromolecular Systems," by H. Eyring (University of Utah); March 10: "Radiation Chemistry of Polymers," by R. F. Boyer (Dow Chemical); March 31: "Physical Chemistry of Biosynthetic Polynucleotides," by R. C. Warner (New York University); April 28: "Ultimate Properties of Polymers," by A. M. Bueche (General Electric); May 26: "Fundamental and Applied Polymer Research in the U. S. S. R.," by H. F. Mark (Polytechnic Institute of Brooklyn).

► The Los Angeles Rubber Group held its regular meeting at the Biltmore Hotel on February 2. Highlight of the dinner meeting was a talk by John Pettley, noted British humorist, whose topic was "An Englishman at Large in America." Walter J. Dugan (General Electric) was the speaker at the technical meeting. According to Mr. Dugan, introduction of reinforced gums to the silicone rubber market represented the first major change in product type since silicone rubber gums were introduced in 1951. Rubber fabricators, he said, now have the choice of using a wide variety of silicone rubber compounds; of producing their own custom compounds from silicone rubber gums; or of taking the newest approach by compounding from reinforced gum.

Each approach has its own particular advantages and will be best for certain fabricators, Mr. Dugan said. He then went on to discuss the technology of the newer types of reinforced gums and to analyze the equipment requirements, relative compound costs and other factors to be considered in making the decision to use purchased compound, gum or reinforced gum.

► B. F. Goodrich Chemical Co., Cleveland, Ohio, has announced plans for the construction of a plant in Watson, Calif., to produce vinyl resins and compounds. According to the company, construction is already under way with completion scheduled during the latter half of 1960. The Watson plant will become the seventh domestic manufacturing facility of the company, and its first plant west of the Mississippi River. The Geon vinyl materials to be produced at the Watson plant are used in making many articles ranging from such consumer products as rainwear, upholstery material, luggage, floor tile and phonograph records to such industrial applications as electrical insulation, pipe, ductwork, sponge, and specialty coatings, the company states. Goodrich Chemical feels that the new facility will enable it to better serve the needs of the growing West Coast market.

► Raybestos-Manhattan, Inc., Passaic, N.J., has announced plans to build a plant at Fullerton Industrial Park, Fullerton, Calif. According to the company, the new plant will provide improved and expanded facilities for the production of items made of Teflon and nylon now manufactured in its rented plant at Paramount, Calif. Construction of the Fullerton plant is under way, and completion is scheduled for July 1960. The plant will contain about 25,000 square feet of manufacturing space, and will be situated on an 18 acre tract.

► Henry Murata, formerly chief chemist at the Byron Jackson Division of the Borg Warner Corp., is now at the Kirkhill Rubber Co.

Anthony V. D'Amelio

Named Sales Development Manager

► U B S Chemical Co., Cambridge, Mass., has announced that Anthony V. D'Amelio has been named to the post of sales development manager. Previously sales office manager, Mr. D'Amelio will be responsible for the sales development of industrial adhesives and shoe chemicals as well as the supervision of the internal sales staff. A graduate of the University of Massachusetts, Mr. D'Amelio was employed as a technical sales representative for Union Carbide & Chemicals Co. prior to joining U B S in 1957.

To Extend Terra Tire Line

► Goodyear Tire & Rubber Co., Akron, Ohio, plans to extend its line of Terra-Tires in order to meet increasing demand. The tires, ranging in height from 16 inches to five feet are now available in 20 sizes with varying tread patterns depending on intended use. Terra-Tires are said to be able to go virtually anywhere conventional tires cannot go because of extra large ground contact area or footprint, low rolling resistance, low ground-bearing pressure, high strength and flexibility. According to Goodyear, builders of industrial and commercial vehicles have been under pressure to produce specialized equipment for use in areas where conventional tires cannot operate effectively.

FMC Magnesia Line Enlarged

► Mineral Products Division of Food Machinery and Chemical Corp., New York, N. Y., has enlarged its line of magnesias to include magnesium oxide for neoprene-type rubber. The new product, Seamag, is made at FMC's magnesias-from-seawater plant at Newark, Calif. Commercial production of Seamag follows research and process development work by FMC at the Newark plant and testing by a leading independent rubber laboratory and by commercial users of neoprene grade magnesias. Reactive qualities of the new material include acid acceptance and anti- scorching properties. It also serves as a filler.

Food Additives Amendment Discussed

► Staff representatives of the Rubber Manufacturers Association recently met with officials of the U. S. Food and Drug Administration to discuss the construction and application of the Food Additives Amendment. RMA representatives hoped to clarify uncertainties as to the applicability of the act to rubber products used in food processing. FDA had advised the association that it would grant no industry-wide extensions under the Food Additives Amendment of 1958 beyond the present deadline of March 6, 1960.

The meeting was called to determine what the law will require of rubber manufacturers and also to develop a "white list" of rubber products, based on end use, that would be acceptable to FDA for the purpose of establishing exemptions. RMA's role would be to determine the facts and to advise manufacturers, where possible, on government requirements with respect to packaging materials, rubber items and similar materials used in the food industry.

The statute will apply after next March 6 if there are substances in these products that would extract or migrate out of the products and become components of the foods with which they are in contact. If such substances that may extract or migrate out are recognized as safe, they are not "food additives" insofar as the statute is concerned.

Southern Ohio Christmas Party

► The Southern Ohio Rubber group held its annual Christmas party on December 12 at the Miami Valley Golf Club in Dayton, Ohio, with 140 couples in attendance. Door prizes were awarded to 94 lucky ticket holders, and each lady present received a compact. Don Strack (Inland Mfg.) served as party chairman and Jim Williams (Amsco Solvents) served as co-chairman. Mr. Williams will serve as chairman of the 1960 Christmas Party. During the festivities, the 1960 officers of the group were introduced, they are: *Chairman,* Fred Gage (Dayton Chemical); *Chairman-Elect,* Howard Gillette (Precision Rubber); *Secretary,* R. Mempelman (Premier Rubber); and *Treasurer,* Roger Headrick (Wright-Patterson AFB).

Promoted by American Hard Rubber

► J. R. Englund has been promoted to manager of the Battery Parts Sales Division of the American Hard Rubber Co., Division of Amerace Corp., Butler, N. J. He succeeds Howard B. Klippel, who is retiring after 32 years with the organization. Mr. Englund joined the company as a sales correspondent in 1941 and advanced through various sales assignments to become manager of the Chicago sales office, prior to his transfer to headquarters as assistant to Mr. Klippel in 1959.

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Financial News

Firestone Sales and Earnings Hit Record High in 1959

► Firestone Tire & Rubber Co., Akron, Ohio, reports that its sales and earnings for the fiscal year ended October 31, 1959, were the largest in the history of the company, although a strike covering eight weeks of the principal tire-selling season halted production from April 15 to June 12, and the volume of defense business materially decreased. Net sales for the 1959 fiscal year amounted to $1,187,784,024, compared with $1,061,590,801 in the previous fiscal year. Net income for 1959 was $64,596,848, equal to earnings of $7.48 per share of common stock, compared with $53,751,650, or $6.23 per share for the like 1958 period. Profits of foreign subsidiaries were $18,578,206, from which the company provided a reserve of $1,476,311 for profits which could not be remitted during the year because of exchange difficulties. The year before such profits were $15,070,768 and a reserve of $584,600 was provided. Devaluation of foreign assets resulted in a charge in 1959 of $1,576,799 to a reserve provided from income in prior years, Firestone's net working capital on October 31, 1959, was $394,491,835, compared with $359,961,160 on October 31, 1958, a gain of $34,530,675. The company's expenditures for additions and improvements to plants and equipment totaled $48,476,032, compared with $37,766,473 the year before.

National-Standard

► Year ended September 30: Net income of $3,769,000, which is equal to $4.81 per share of common stock, compared to $2,136,000, or $2.75 per share for the previous fiscal year. Net sales for the year totaled $54,716,000, compared with $38,987,000 in 1958.

A. G. Spalding

► Year ended October 31: Consolidated net income amounted to $1,116,710, or $1.35 per share, compared with the 1958 figure of $801,092, equal to earnings of 97c per share. Net sales for the 1959 fiscal year totaled $46,123,353, compared with $42,435,161 in 1958.

Long Mile Rubber

► Six months ended November 21: Net income amounted to $403,875, equal to earnings of 65c per share of common stock. Net sales totaled $4,519,563. Figures for 1958 are not available.

Catalin

► Year ended December 31, preliminary report: Net income after taxes and non-recurring loss of $41,641 on sale of obsolete equipment, amounting to $74,511, equal to earnings of 7c per share of common stock, compared with $176,790, equal to 13c per share for the like 1958 period. Net sales totaled $22,261,366 compared with $20,783,127 for the 1958 fiscal year.

Diamond Alkali

► Year ended December 31, preliminary report: Net income after taxes amounted to $11,332,000, equal to $3.90 per share of common stock, compared with $6,474,962, or $2.23 per share for the same 1958 period. Net sales for 1959 amounted to $137,874,000, compared with $114,186,498 for the like period of 1958.

Reeves Brothers

► Six months ended January 2: Net income after taxes amounted to $1,277,643, equal to earnings of $1.10 per share of common stock, compared with $119,337, or 10c a share for the like period a year ago. Net sales for the six-month period totaled $32,878,123, compared with $25,978,517 for the like period of 1958.

Plastic Wire & Cable

► Year ended October 31: Net income for the fiscal year amounted to $462,934, equal to common share earnings of $1.97, compared with $300,148, or $1.60 per share for the like period of 1958. Net sales for 1959 totaled $12,311,796, compared with $10,093,713. pared with $3,149,256.

Alco Oil & Chemical

► Year ended September 30: Net income amounted to $419,815, equal to earnings of 14c per share of common stock, compared with $29,662, with no earnings per share reported for the like 1958 period. Net sales for the 1959 fiscal year totaled $5,300,393, compared with $3,149,256 for the previous year.

Lee Rubber & Tire

►Year ended October 31: Net earnings for the year amounted to $1,521,479, equal to $1.78 per share of common stock, compared with $1,797,919, or $2.12 per share of common stock for the 1958 fiscal year. Net sales 1959 totaled $52,164,161, compared with $46,558,852 for 1958.

Michigan Chemical Names Three

► Michigan Chemical Corp., Saint Louis, Mich., has announced the appointment of E. Russell Leach as sales manager and Max R. Sias as manager, sales administration. The company also has announced that Donald E. Hipchen has joined its Operations Division. Mr. Leach, a graduate of Indiana University in 1941 with a B. S. degree in chemistry, was with Wyeth, Inc., prior to joining Michigan Chemical in 1952. He previously was product manager of industrial and pharmaceutical chemicals for Michigan Chemical, and will now be in charge of field sales activities on all products except salt, rare earths and ethical pharmaceuticals. Mr. Sias, who received his business training at Cleary College, will be in charge of the firm's sales office and Order Department with headquarters in Saint Louis. Mr. Hipchen is a graduate of the University of Pittsburg, from which he received a B. S. degree in chemical engineering in 1954. Prior to joining Michigan Chemical, Mr. Hipchen was in the Production Department of the Plastics Division of Union Carbide Corp.

Completes New Hose Plant

► North British Rubber Co., a subsidiary of the U. S. Rubber Co., has begun operations at a modern hose factory in Edinburgh, Scotland, as the major and final phase of an $8.5 million expansion and modernization program begun in 1956. The facility is one-story brick and steel structure with 84,000 square feet of manufacturing space. The plant was erected on a 7 acre plot of the company's 22 acre factory site in the heart of Edinburgh. It has two 70 foot wide bays, each 600 feet long, which permit direct-flow construction of hose from the reception of raw materials at one end of the structure to shipment of finished goods from the far end. Room is also available for the construction of a third bay, when needed, which would allow a 50 per cent boost in production. Varieties of hose in production at the plant are air, water suction, steam, spray, chemical, oxy-acetylene, brewers, sand-blast, tar-spraying, and fire-fighting.

J. O. Ross Builds Detroit Offices

► Ground was broken recently for the new Detroit offices of the J. O. Ross Engineering Division of the Midland-Ross Corp., New York, N. Y. The new building, located at 13050 Puritan Avenue, was to have been completed early in February. It was designed to house engineering and office personnel of Ross, plus representatives of the Midland-Ross Corp. "The growing number of employees, plus the increasing scope of Ross services for various industries, necessitates the move", said Saxton W. Fletcher, president of Ross Engineering.

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290,000,000 passengers in one year

make little impression on seat fabric

Public Service Coordinated Transport, owner and operator of 2511 buses in New Jersey, with established routes into the cities of New York, Philadelphia and Wilmington, carried 290,000,000 passengers over 90,000,000 miles in 1958 alone. Impressive as these statistics sound, they made little or no impression on the heavy duty coated fabric upholstery used by the company. So sturdy is this material that much of Public Service's original purchase, made in 1947, is still standing up under everyday use.

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Eastman Marketing Inhibitors

► Eastman Chemical Products, Inc., Kingsport, Tenn., has announced that it is planning to market four inhibitors to protect polymers from degradation. The inhibitors, available in development quantities are: HPT (hexamethyl-phosphoric triamide); RMB (resorcinol monobenzoate); OPS (*p*-octylphenyl salicylate); and THBP (trihydrozybutyrophenone). According to Eastman, HPT, RMB and OPS can be used as ultraviolet stabilizers, and the HPT, a clear, light yellow, soluble liquid, is intended for vinyl plastics. The company reports that RMB has been used successfully in cellulosic plastics. OPS can be used in polyethylene and polypropylene and its special feature, according to Eastman, is its compatibility with resins. THBP is a crystalline antioxidant for polyolefins and paraffin waxes. Eastman claims that its tests indicate that polyethylene with 0.1 per cent THBP is more than 2½ times more stable to oxidation than is a control sample.

Plans To Double Sales

► Pennsylvania Tire Co., Mansfield, Ohio, has announced plans for doubling its tire and tread rubber sales in the next five years. J. H. Hoffman, president of the company, predicted that 1960 would be a record year for original equipment and replacement tire sales, the first such double peak year since 1955. Mr. E. V. Duffy, vice-president of the company, states that the most important part of Pennsylvania Tire's plans for doubling over-all sales in the next five years would be played by its new tire manufacturing plant in Tupel, Miss.; the new Paris, Texas, tread rubber producing plant; and other manufacturing facilities, both new and old. The statements were made during a recent four-day sales conference which was held recently by the Pennsylvania Tire Co. for 90 of its division, territory sales and credit managers at Mansfield, Ohio.

General Simplifies Tire Curing

► General Tire & Rubber Co., Akron, Ohio, has announced the development of a 134-inch, single giant tire curing unit, with half the mold attached to the lid and the other half to the base of the heater-press. According to the company, this new tire curing method is the first step towards a more efficient giant tire vulcanizer and will substantially reduce the curing cycle. The heater, designed by Glenn Orr, chief engineer at General Tire, requires only 20 minutes to prepare a tire for curing, compared with the old method of from one to two hours, the company states. The new heater is now in active operation at General's Akron tire plant. Three additional units are planned and they will be housed in a 4,800 square foot, specially constructed building, according to a company report.

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Davis-Standard
Thermatic* Extruder
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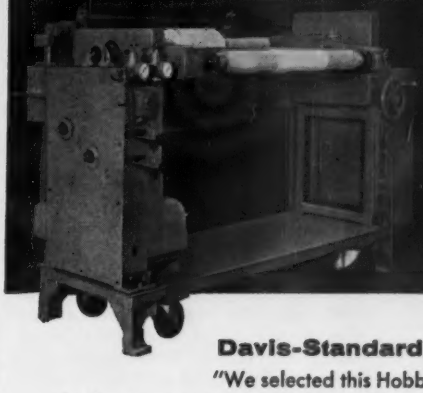

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The 44" Hobbs Versawind shown here is joined to a Thermatic Extruder, Die and Blown Film Tower manufactured by Davis-Standard, a division of Franklin Research Corporation of Mystic, Connecticut. Operating on a 5-day a week basis, the unit tests batches of thermoplastics sent in by extruder customers and runs pilot extruder tests.

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Obituaries

George F. Weaton

► George F. Weaton, former plant manager of the St. Joseph Lead Co., Monaca, Penna., died at his home near Monaca on December 4. He was 73 years of age. Mr. Weaton's early career was with General Electric Co., and later with J&P Coates Co., in the field of steam generation and electric power production. Later he became associated with the Thomas A. Edison Co. as chief engineer. He was awarded an honorary degree in mechanical engineering by Stevens Institute of Technology. In 1921 he became associated with St. Joseph Lead and was in charge in southeast Missouri of its power generation and power distribution facilities. In 1926, he was appointed an engineering consultant to a pilot stage project at the firm's Herculaneum, Mo., smelter, and in 1928 he was named manager of the project. Mr. Weaton retired in 1954, and had served the company as a consultant until 1958. In 1958-1959, he supervised the design and installation of a 100,000 KVA power plant at Josephtown, Penna. This power station has been named in his honor, "George F. Weaton Station." Mr. Weaton was a member of the Rubber Division, ACS, and of its 25-Year Club, the Akron Rubber Group, and the American Institute of Mining, Metallurgical and Petroleum Engineers. He is survived by his wife, three sons and three daughters.

Zimri C. Oseland

► Zimri C. Oseland, treasurer of Goodyear Tire & Rubber Co., Akron, Ohio, died on December 24 as a result of injuries sustained in a fire at his home in Akron. He was 62 years of age. Mr. Oseland attended the School of Economics in London, England, and New York University. A native of St. Louis, Mo., Mr. Oseland joined Goodyear in 1929 as assistant treasurer. Prior to joining the company, he worked for several banks and the U.S. Department of Commerce. In 1937, he was named treasurer of Goodyear. He is survived by his wife and a son.

John F. Wright

► John F. Wright, retired engineer with Goodyear Tire & Rubber Co., Akron, Ohio, died on December 23 at his home in Akron. He was 90 years old. A native of Elderton, Penna., Mr. Wright taught school in Pennsylvania after graduating from Indiana (Penna.) State Normal School. Mr. Wright was with Firestone for over 25 years. He is survived by three sons.

Willett S. Chinery

► Willett S. Chinery, retired vice-president of Industrial Rubber Goods Co., St. Joseph, Mich., died at his home in St. Joseph on December 25. He was 78 years old. Mr. Chinery attended Rensselaer Polytechnic Institute and the University of Akron. In 1913, he began his long career in the rubber industry when he joined the S.S. White Co. He also held positions with such companies as Standard Tire Co.; Firestone Tire & Rubber Co.; Kokomo Rubber Co.; and Brown Rubber Co. Mr. Chinery was one of the founders of Baldwin Rubber Co. In 1941, he joined Industrial Rubber Goods as its chief chemist, and was with the company until his retirement in 1958. Mr. Chinery was a member of the American Chemical Society, the Rubber Division, ACS, and the Chicago Rubber Group. He is survived by his wife and a son.

Edward R. Snyder

► Edward R. Snyder, retired executive vice-president of the Barrett Division of Allied Chemical & Dye Corp., died on December 13 at his home in Montclair, N. J. He was 74 years old. Born in Newtown, Penna., Mr. Snyder received a degree in mechanical engineering from the University of Pennsylvania in 1906, and joined Barrett the same year. In 1931 he was named a vice-president of Barrett, and in 1935, was appointed vice-president and general manager of the then Barrett Division of Allied Chemical & Dye. Mr. Snyder retired in 1945, after 39 years of service with Barrett and Allied Chemical. During World War II, Mr. Snyder served as a member of the Office of Price Administration Advisory Committee for the coal tar industry. He is survived by his wife and three daughters.

William L. Gosling

► William Lee Gosling, former manager of the Export Division of General Tire & Rubber Co., Akron, Ohio, died on December 20 at St. Thomas Hospital in Cuyahoga Falls, Ohio. He was 72 years old. Mr. Gosling was born in Manchester, England, where he attended the School of Commerce. He studied textile spinning and weaving at the Salford School of Technology in England. In 1920, Mr. Gosling went to work for the Canadian export corporation of Goodyear Tire & Rubber Co., and in 1924, he moved to Goodyear's Akron office. In 1931, Mr. Gosling joined General Tire, and retired in 1956, after 25 years with the company. He is survived by his wife and a son.

Ludwig C. Boos

► Ludwig Charles Boos, vice-president of U.S. Rubber Co., and general manager of its International Division, died on December 8 in Cos Cob, Conn. He was 56 years old. Mr. Boos was born in Trinidad, British West Indies, and began his career in the rubber industry in 1923 when he joined U.S. Rubber as an apprentice. In 1926 he became tire sales assistant in the export company, and in 1928 he was sent as special representative to Puerto Rico and later to Central America. He subsequently became branch manager in Puerto Rico and Cuba, and was appointed managing supervisor of all of the company's Caribbean activities in 1939. In 1941, he became head of the U.S. Rubber Export Co., Ltd., and continued in that capacity until 1952, when the export company dissolved and he was made vice-president and general manager of the newly-formed International Division.

Mr. Boos was president and director of U.S. Rubber International Corp., U.S. Rubber Co., Ltd., Cuba; U.S. Rubber Mexicana S.A., Mexico; and U.S. Rubber Internacional de Venezuela. He was also a director of U.S. Rubber International (Great Britian) Ltd., London, England; The North British Rubber Co., Ltd., Edinburgh, Scotland; U.S. Rubber International, Brussels, Belgium; The Rubber Regenerating Co., Ltd., Manchester, England; Lastex Yarn and Lactron Thread (Overseas) Ltd., London, England; Societe Europeenne de Fils Elastiques, Paris, France; Pirelli Lastex Societa Italo Americana Filo Elastico S.p.A., Milan, Italy; The National Foreign Trade Council; Rubber Export Association; Inter-American Safety Council Inc; and the International Road Federation. He is survived by his wife and a daughter.

Harold R. Turner

► Harold R. Turner, vice-president of J. P. Stevens & Co., died on January 2 in Greenville, S. C. He was 62 years of age. Mr. Turner attended Furman University and Clemson College. In 1922, he joined one of several textile concerns that were merged into J. P. Stevens in 1946. He was named a vice-president in 1952. Since May, 1958, Mr. Turner was in charge of manufacturing in all 17 of the company's plants in Virginia and North and South Carolina.

Leland W. Fox

► Leland W. Fox, retired manager of the Field Engineering Division of the Development Department of Firestone Tire & Rubber Co., Akron, Ohio, died on December 10 in West Orange, N. J. He was 65 years old. Mr. Fox was a graduate of Syracuse University with a degree in engineering. He retired from Firestone in 1957, after 35 years of service.

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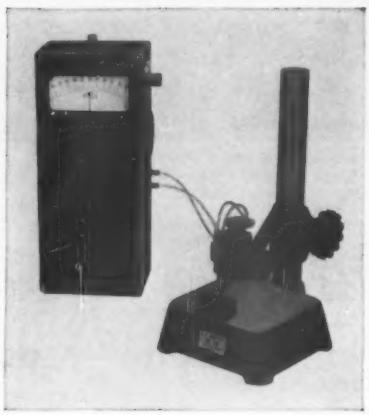

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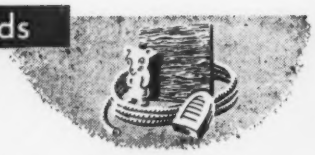
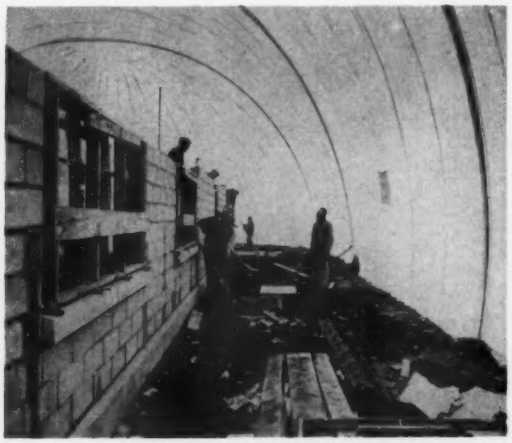


All-Weather Nylon Structure

► B. F. Goodrich Chemical Co., Cleveland, Ohio, reports the development of an air pressure supported vinyl coated nylon structure which makes possible year-round, man-made weather for outdoor workmen. Called the Air:Seal Airhouse, the dome-like structure is made from nylon fabric which has been coated with a plastisol based on Geon vinyl resin. According to the company, the Geon plastisol coating gives the fabric long



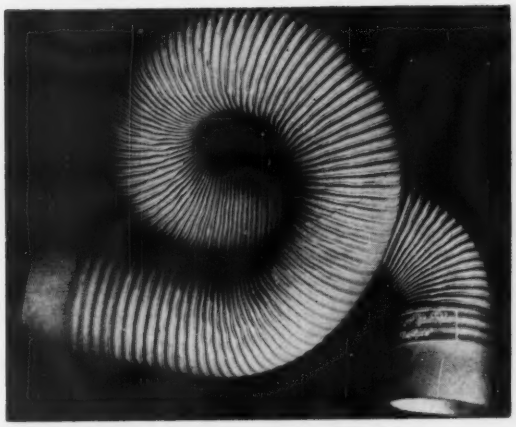
life, colorfastness and flexibility in all kinds of weather. Tests have shown that an airhouse 60 x 110-feet with a 30 foot center height could not only be heated, but pressure supported by a 450,000 BTU portable heater. For support purposes alone, conventional cage-type blowers are used. Actual working conditions showed that the use of Air:Seal Airhouse with a heater enabled inside temperatures of 50 to 60 degrees to be maintained while the outside air was 20 degrees. The airhouse is manufactured by the Industrial Products Division, Seattle Tent & Awning Co., Seattle, Wash., and the fabric is produced by Cooley, Inc., Pawtucket, R.I.

Naugahyde Vinyl Upholstery

► U.S. Rubber Co., New York, N.Y., has introduced a new line of elastic Naugahyde for furniture upholstery in 20 colors—from basics to such special home furnishing tones as absinthe green and espresso brown. Called Chromata in view of this color range, the vinyl material is said to be especially smooth and supple, with a rich-looking, dull finish. It has been designed for use by furniture manufacturers, decorators and upholsterers. It is 54 inches wide, elastic fabric backed and, according to the manufacturer, will tailor easily and give exceptional wear.

Impermeable Flexible Duct

► Flexflyte L-1, a new grade of highly impermeable flexible duct, meeting MIL-H 8796A specifications, is available from Flexible Tubing Corp., Guilford, Conn. The duct comes in sizes from ½ inch to 12 inches in diameter. To meet the impermeability requirements, the neoprene coating of the fiber glass base fabric of the duct was specially developed for this application by Vulcan Rubber Products Division, Reeves Brothers, Inc., New York, N. Y. The Flexflyte line of lightweight, reinforced fabric duct is intended for permanent and semi-permanent installations requiring optimum air flow efficiency, and it can also be used for flow of liquids, gases, light solids, and chemicals, the company states.



The duct is designed primarily for low pressure venting in aircraft, missiles, and other automotive applications. The company recommends its use for many industrial applications where extreme temperatures are encountered, or where high impermeability of the duct is desirable. Operating temperature range of Flexflyte L-1 is from —65°F. to 300°F. The neoprene coated fiberglass fabric remains fully flexible within this range, the company claims. In addition, the material does not support combustion and is exceptionally flame resistant. The duct operates with working pressure of up to 40 psi internally, 15 psig externally.

Self-Righting Life Jacket

► Stearns Manufacturing Co., St. Cloud, Minn., has produced a life jacket that automatically rights its wearer, holding his head above water. It is made of lightweight Ensolite, covers the body from chest to waist and is held in position by a strap. The top part of the jacket forms a high collar which holds the wearer's head above water. The company states that if a person were unconscious when he hit the water, the jacket would automatically turn him chest up and keep him in a reclining, sitting position.

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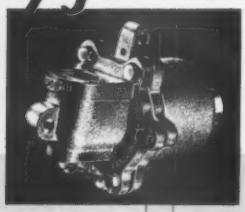

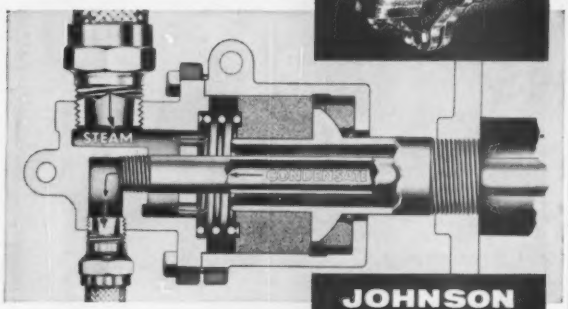

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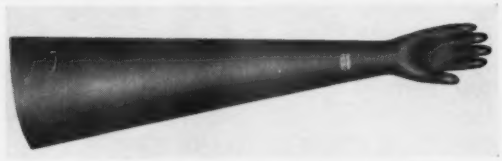
Dry Box Gloves

► Industrial gloves specifically designed for handling radioactive materials under dry box conditions have been introduced by the Surety Rubber Co., Carrollton, Ohio. The Dry Box Gloves are reported to be particularly suitable for the



manipulation of delicate atomic materials because of their extreme suppleness and flexibility.

The new gloves are fabricated of rubber, neoprene or Sureseal, according to users' specifications. They are being distributed to afford hand protection wherever "hot" materials are handled —from university laboratories and independent research centers to atomic plants, armed forces, shipyards and power stations.

Compressed Asbestos Sheet Packing

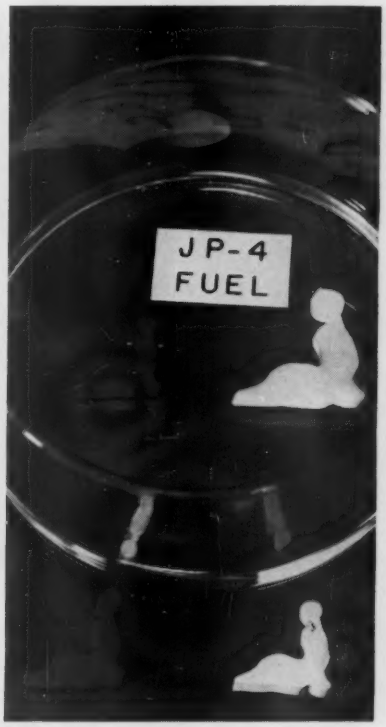
► A new line of compressed asbestos sheet packing designed primarily as a gasketing material for a wide variety of industrial uses has been developed by Union Asbestos and Rubber Co., Bloomington, Ill. The packing is available in eight basic grades in standard size sheets including: commercial, intermediate, Navy, premium, neoprene, premium neoprene, and blue asbestos. The company reports that commercial grade sheets are designed for general purpose use in making gaskets for industrial applications involving steam, gas and air at high temperatures. Average tensile strength of the material is 3,000 psi; density is 1.1 ounces-per-cubic-inch. The sheets are available in black, Style 10-1, and in white, Style 10-4, and meet the requirements of ASTM D 1170-58T and P 1161-A, the company states.

U.S. Rubber Tarpaulin Materials

► U.S. Rubber Co., 1230 Avenue of the Americas, New York, N. Y., has developed a new truck tarpaulin material which is reported to take three times the punishment of comparable tarps on the market. The new material, a neoprene coated nylon, has been made part of the company's Fiberthin line. Designated as Fiberthin 71514T-Truck, the material offers 300 per cent more abrasion resistance than other current neoprene materials, and greatly improved bond of the coating to the nylon, the company claims. The adhesion is rated by the company at 40 pounds per square inch, and is unaffected by moisture. These improvements result in a tarp with superior wind-whip resistance, according to U.S. Rubber.

SILICONE NEWS from Dow Corning

New Base For New Products



SILASTIC® Solvent-Resistant Masterbatch

For the first time solvent-resistant silicone rubber can be compounded by the rubber fabricator to his exact needs, through the use of new Silastic LS-422 Base. This masterbatch consists of a fluorocarbon silicone polymer and reinforcing silica.

Fuel, oil, and solvent-resistant stocks with hardnesses up to 80 durometer may be formulated from Silastic LS-422 Base. Elongation, tensile strength and other physical properties can be varied. In effect, this new base allows you to tailor-make stocks to meet your customer's requirements. Yet you need inventory only the one masterbatch.

Solvent resistance of stocks compounded from this base is comparable to that of the Dow Corning LS series. The photo at right above shows how little swell results when an extrusion of a stock made from LS-422 base is immersed for 24 hours in JP-4 jet fuel. Note swelling of regular silicone rubber part that was the same size at the start of the test.

Silastic LS-422 base processes easily during compounding . . . bands quickly, doesn't crumble, accepts fillers readily, can be stripped from mill rolls with a knife. Finished stocks can be molded, calendered or extruded. Even the most complex extruded shape is sharp and clear as shown in photo at above right. Write Dept. 9202 for full details.

Sample Recipes and Typical Properties

. . . For 50 Durometer Stock	
Silastic LS-422 Base	100 parts
Luperco CSF or Cadox TS-40	2 parts
Hi Sil X303	8 parts
* Durometer (Shore A)	50
Tensile Strength, psi	1000
Elongation, %	200
% Swell after 77 hrs @ 300 F in ASTM No. 3 Oil	5
. . . For 75 Durometer Stock	
Silastic LS-422 Base	100 parts
Luperco CSF or Cadox TS-40	2 parts
Hi Sil X303	5 parts
Super Neo Navacite	90 parts
* Durometer (Shore A)	75
Tensile Strength, psi	500
Elongation, %	120
% Swell after 77 hrs @ 300 F in ASTM No. 3 Oil	5

* Vulc. 5 min @ 240 F; cured 24 hrs @ 300 F.

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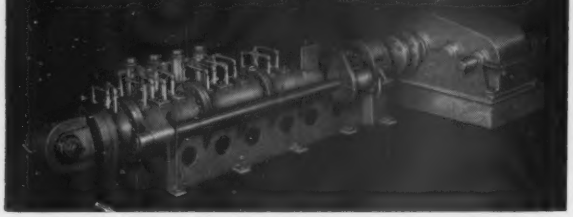

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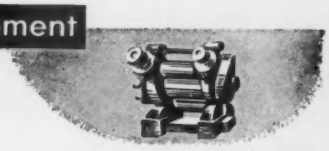
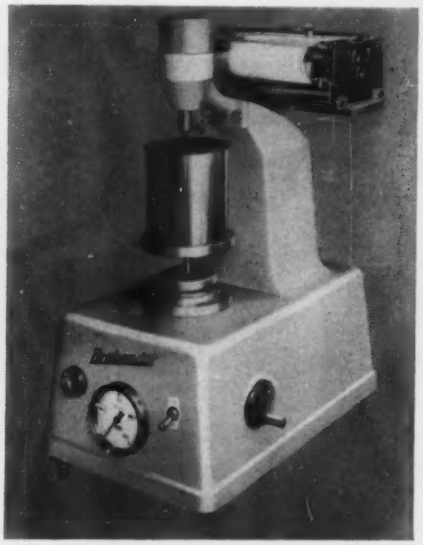


Fully Recording Viscometer

► Determination of the viscosity and flow characteristics of a wide variety of materials, both Newtonian and non-Newtonian, can be accomplished quite easily with this new, fully recording, completely linear viscometer, states the manufacturer, C. W. Brabender Instruments, Inc., South Hackensack, N. J. Called Visco-Corder, the unit is said to be a companion to the firm's Visco/amylo/Graph. Available with 15 paddle designs, the Visco-Corder measures viscosity of practically



all fluids such as epoxies, gels, starches, inks, paints, plastisols, chocolate, catsup, glues, oils, tars, pastes, clay, milk, cements, etc., the company claims. Changes in viscosity are automatically recorded providing useful information form the plotted curves. The company reports that conversion from its units already in use to other viscosity units may be readily made, since the new instrument is completely linear. Other features of the Visco-Corder include a stepless variable speed drive (20 to 200 rpm,) disposable paddles and sample containers, and interchangeable tension spring cartridges from 125 to 2,000 cmgms.

Munson Ribbon Blender

► A new ribbon blender, which is reported to give 20 to 200 cubic feet of thorough blend, has been engineered and is being marketed by Munson Mill Machinery Co., Utica, N. Y. According to the manufacturer, outstanding features of the blender include a wide range of capacities, elimination of contamination, controlled agitation,

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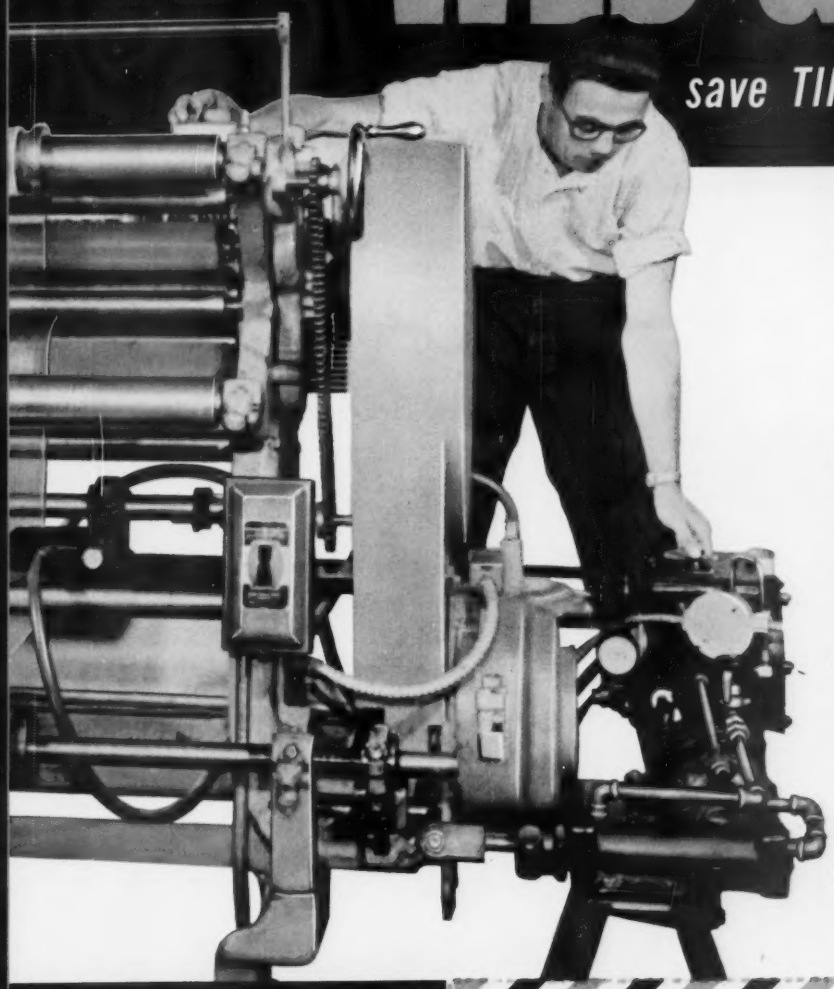

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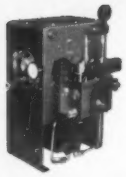

Model 558MA-1—Light-duty unit with local and remote manual/automatic control and automatic locking, for ease of start-up.

Model 525—Twin unit, light duty, for operating both rails of tenter frames, also as two separate controls for laminators, etc.

Model 108PJ—Medium-duty, widely used for film, foil, and paper, and for light-duty applications in the rubber industry.

Model 25—Heavy-duty twin unit for tenter frame applications or medium-duty applications on laminators, etc.

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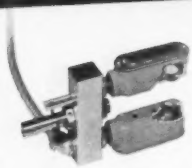

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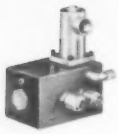
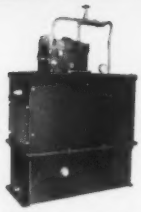


Solenoid-operated locking valve, available on all models, cuts automatic control in and out automatically. Also furnished as high-speed fail-safe.

Model 300—Heavy-duty, for control loads up to or in excess of 100 tons. Used primarily in the basic metal industries.



Model 110—Heavy-duty, for steel, rubber, and paper industries. Like other models, can be furnished for center-line control.

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maintenance-free operation and low power requirements. The all-welded, heavy duty tub is equipped with externally adjusted packing glands, while the agitator is a reversing double spiral ribbon supported on heavy duty outboard bearings. Available with internal spray lines for liquid addition, the ribbon blender's drive options include countershaft and chain drive combination or torque arm and V-belt drive. The unit is available in two types, standard and sanitary.

Custom-Engineered Presses

► A new precision-built line of hydraulic presses that may be custom-engineered for all types of compression molding, transfer molding, or laminating has been announced by Atlas Hydraulics Division, Delaware Valley Mfg. Co., Inc., 3576 Ruth Street, Philadelphia, Penna. According to the company, this new line of presses was developed for exceptional laboratory conditions where pressure, temperature and work results must be consistently reproduced each and every time.

Laminating or molding tolerances can be held to plus or minus one-thousandths of an inch due to a newly designed deflection free slab side frame and a new type of platen guiding arrangement that produces true parallel movement of platens, the company states. Each press is custom designed and engineered, in any size or capacity, to suit individual applications and then economically built from standard component parts, Atlas claims. According to reports, electric or steam platens can be equipped with special controllers to maintain precise temperatures in any desired range up to 1000°F. A new self-contained pumping unit automatically maintains any preset hydraulic pressure, during the entire cure cycle, without personal attention, according to a company statement.

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This is the first book ever published which thoroughly covers the entire rubber industry, including synthetic elastomers, latices of both natural and synthetic rubbers, and even the pertinent plastics, in less than 500 pages.

It is written especially for the busy rubber chemist and technologist, beginner and student, who have no time to untangle the details they really need from a maze of compiled literature.

Utility is the keynote of the book. With judicious selection from the latest developments in rubber chemistry and physics, theories of elasticity, vulcanization, accelerators, reinforcement, antioxidants, etc., and the most up-to-date procedures of rubber technology and testing, it provides a well-balanced, concise but comprehensive treatise on this vital commodity.

Special attention is given to the principles of selecting the most suitable compounding ingredients to meet the specifications placed on the finished product.

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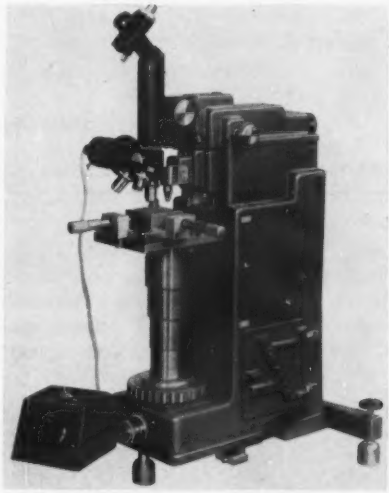
Micro Hardness Tester

► The Model AK 8 Kentron Micro Hardness Tester, developed by Torsion Balance Co., Clifton, N. J., can apply dead weight loads from 1 to 1000 grams, up to 10,000 grams with optional equipment. The Model AK 8 with its vertical capacity of 8 inches is basically a production



control instrument offering the same accuracy controls as the standard research Model AK, used in metallurgical laboratories. The new tester is designed to test unmounted parts so that they can be returned to production or the stock bin. Among the other materials that can be tested are mounted specimens, small parts, sheet metal and wire.

Aminco Deflection Tester

► American Instrument Co., 8030 Georgia Ave., Silver Spring, Md., has announced a new instrument, the Aminco Plastic Deflection Tester, that indicates the deflection of thermoplastics when subjected to various loads and temperatures in accordance with ASTM Test D648-56. As many as four samples can be tested simultaneously by placing each in a specimen holder and lowering the holders into an insulated bath. Deflections are indicated on dials mounted on the specimen holders. Only 26 x 16½ x 23 inches high, this instrument is said to be ideally suited for materials-testing laboratories with limited space. Handles are attached on either side of the tester so that the unit may be easily moved.

The Plastic Deflection Tester operates on 230-volt, 60-cycle, single-phase. The bath temperature can be increased at the rate of 2°C. per minute from ambient to 260°C., or maintained constant at any point within this range. With the addition of a few accessory items, the tester can also perform Vicat Penetration Tests of polyethylenes and other materials as specified in ASTM Test D1525-58T.

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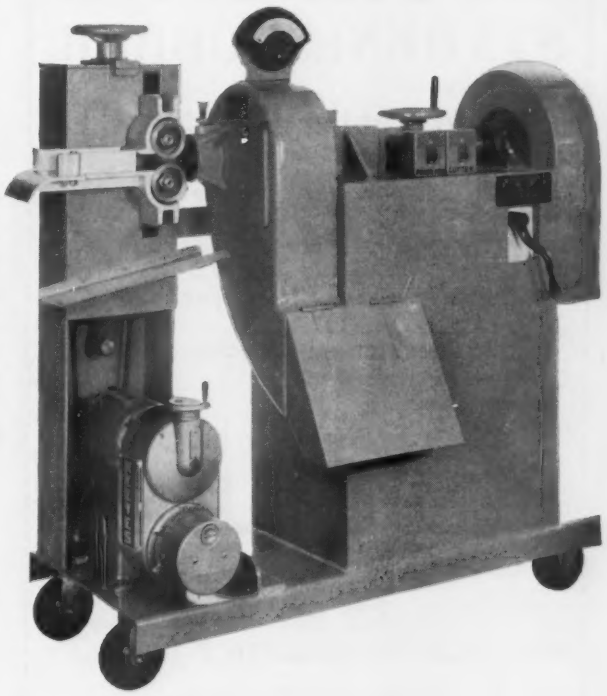

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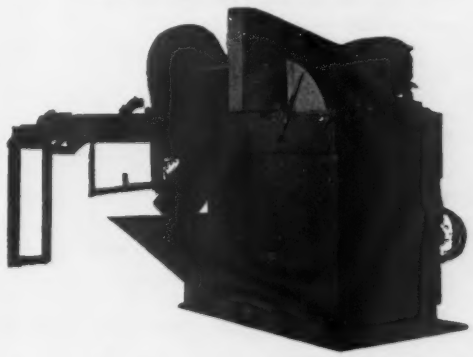

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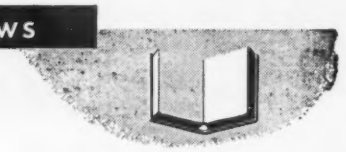
Reviews



Radioisotopes for Industry. By Robert S. Rochlin and Warner W. Schultz. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22, N. Y. 7½ x 5 in. 190 pp. $4.75.

The use of radioisotopes in manufacturing, engineering and research continues to accelerate as new applications are uncovered. These materials have saved time and money in virtually every industry, including rubber manufacturing, and have often provided solutions to processing and control problems previously unsolved. This book offers a good general introduction to the versatility of these new tools, citing numerous representative examples of isotope applications in thickness gages, radiography, wear measurement, tracer techniques and leak location. Chapters devoted to these uses are followed by discussions of personnel safety, facilities for handling radioisotopes, and setup costs.

Since most of the material is drawn from Atomic Energy Commission reports, the presentation is somewhat one-sided with hardly any mention of difficulties facing the potential isotope user in adapting existing machinery, obtaining trained personnel or guarding against accidental exposure. The statistics, which likewise tend to err on the optimistic side, put annual savings to rubber and tire makers through use of thickness gages alone between 8.0 and 20.3 million dollars in 1957 when about 120 instruments were in use.

Now that isotopes have ceased to be an industrial novelty, a broad extension of their use depends on price reductions rather than on major technological innovations. No radical changes are envisioned by the authors in their forecast of future applications, but large-scale implementation of irradiation cross-linking techniques to rubber and other high polymers is seen awaiting the availability of cheaper radiation sources. The method which induces better mechanical properties at high temperatures has already proven itself commercially in polyethylene production.

The simple non-technical language of this little book will recommend it to anyone who would like a bird's eye view of the importance of radioisotopes to industry. The appended bibliography can guide him to information on more specific subjects of interest.

•

Techniques of Polymer Characterization. Edited by P. W. Allen. Published by Academic Press, Inc., 111 Fifth Ave., New York 3, N. Y. 8¾ x 5½ in. 256 pp. $9.50.

The past decade has seen the development of many new techniques in the measurement of polymeric substances, many of them either unpublished or dispersed throughout the literature. This collection by eight English scientists and industrial chemists fills a growing need for a critical, up-to-date evaluation of the more important techniques used to characterize high polymers. It represents a valuable addition to the recent number of excellent books on the physics and chemistry of high polymers which were generally restricted to theoretical rather than practical laboratory aspects of the subject.

The editor has done well in adopting two general principles to guide his contributors. First, he has avoided going over old ground by keeping theoretical discussions to a minimum. Second, he has omitted accounts of little-used variants and elaborate methods in order to concentrate on a smaller number of techniques of proven reliability.

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There is no single service that offers greater value to the manufacturer of rubber goods, or to any laboratory or organization concerned with rubber compounds, than THE RUBBER FORMULARY. This monthly service has been supplying compounders with detailed, practical information on almost every type of rubber compound for the past twelve years, serving the rubber industry in very much the same manner the pharmacopoeia serves the pharmaceutical industry.

THE RUBBER FORMULARY is sold on an annual subscription basis (by calendar year) and is issued in monthly shipments of cards, so designed as to make it possible for the user to locate and select formulas meeting specifications for hardness, elongation, tensile range etc., in a matter of minutes. Annual subscriptions are available at $95 a year.

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Like the RUBBER FORMULARY, the STARTER SET utilizes a punched card system of recording and classifying compounds. Individual filing cards are provided for the compound. Notches and imprints on the edge of the card serve for the classification and indexing of each compound. They are so designed that every compound is classified according to the principal physical properties, according to the type of rubber hydrocarbon, and as to whether or not the compound contains carbon black. Additional space is provided so that the user can add his own classifications.

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154	"	for natural rubber, nonblack
276	"	for styrene rubber, black
150	"	for styrene rubber, nonblack
259	"	for nitrile rubber, black
97	"	for nitrile rubber, nonblack
254	"	for neoprene, black
116	"	for neoprene, nonblack
101	"	for butyl, black
57	"	for butyl, nonblack
50	"	for polysulfide, black and nonblack
36	"	for reclaim (all black compounds)
45	"	for Hypalon, black and nonblack
86	"	for silicone rubber, black and nonblack
92	"	for vinyls (all nonblack compounds)
100	"	for miscellaneous other rubbers, black and nonblack
156	"	for blends of general purpose rubbers (natural, styrene, butyl, reclaim), black
71	"	for blends of general purpose rubbers, nonblack
77	"	for blends containing oil-resistant rubbers, black
73	"	for blends containing oil-resistant rubbers, nonblack
2365	compounds	Total

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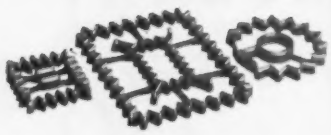

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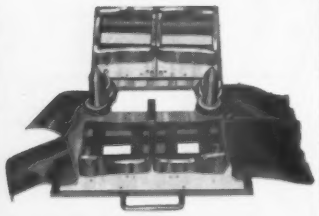

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The book was designed primarily for the graduate chemist familiar with the major works on the subject, but without practical experience in handling and performing measurements on polymeric substances. It has achieved this purpose admirably, and should prove equally useful to the more experienced worker who wants to keep abreast of the latest developments.

•

Asbestos: Its Industrial Application. By D. V. Rosato. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 5 x 7½ in. 214 pp. $5.75.

A comprehensive survey of the many industrial applications that have been found for asbestos compounds is contained in this concise handbook. Introductory chapters present a review of the types of asbestos materials that are available, identifying their physical, chemical and electrical properties. Special attention is given to heat-resistant characteristics which make asbestos strategically important as a constituent of rocket and missile parts.

The author, an engineer who has written several technical articles on the subject, concentrates in this book on a simply written product outline aimed at research and development groups, manufacturers, market researchers and sales management. He draws on information and photographs from major producers of asbestos cement, tile, heat and electrical insulation, friction materials, textiles, packings, gaskets and filters. Specifications of these products are given in a series of tables.

Of particular interest to the rubber industry are references to techniques that combine asbestos with rubber binders to make materials resistant to high temperatures, chemicals, extreme pressures and steam. Brake linings and other friction parts utilize this combination in both woven and molded form. The production process involved in rubber mill lining is treated in a separate section. The chapter on plastics also mentions hot molding and curing methods employing asbestos fillers with rubber or chlorinated rubber binders to solve the engineering problems of packing and gasket seals.

•

Separation and Purification of Materials. By Rolt Hammond. Published by Philosophical Library, Inc., 15 East 40th St., New York 16, N.Y. 5½ x 8 in. 327 pp.

Processes for the separation and purification of materials form a vital stage in all chemical manufacturing. This book describes the major processes employed, their fields of application and their limitations. It covers solid-solid, solid-liquid, solid-gas, liquid-liquid, liquid-gas and gas-gas systems, with a final chapter on the costly and complex procedures required in nuclear engineering. From the multiplicity of plant and equipment available in England, the author has described the main types so that the proper techniques may be chosen for specific purposes.

The volume has been written in semi-technical language on a practical plane to appeal more to the practicing engineer than the student. The section on the distillation of petrochemicals presents a brief account of some rubber vulcanization accelerators. Another section is devoted to the cold acid polymerization proc-

R. A. B. R. M.

Technical Manuals

Conductive Rubber: Its Production, Application and Test Methods

by R. H. Norman

(RABRM Manual No. 1)

The first of several technical manuals produced by staff members of the Research Association of British Rubber Manufacturers, this publication surveys a whole mass of results and presents the main conclusions in a form which can be readily used by the industry. The manual deals extensively with the conductive and antistatic classes of rubber. The effects of stress, time and other variables on resistivity are covered as are test methods and the uses of conductive rubber. A complete index is provided. 99 pages.

$3.50

Ebonite: Its Nature, Properties and Compounding

by J. R. Scott

(RABRM Manual No. 2)

A mine of basic information which will enable the manufacturer of hard rubber (ebonite) to provide products that will give the best possible service. It gives the results of investigations into the dependence of mechanical, electrical and other properties on composition, vulcanization, etc. It covers such subjects as improving the resistance to "plastic yield" and reducing surface deterioration in light. Resistance to swelling action of organic liquids and solvents is also discussed. 294 pages.

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Analysis of Rubber and Rubber-Like Polymers

by W. C. Wake

(RABRM Manual No. 3)

The first modern work devoted solely to this important subject to be published in the English language. In addition to an analysis of natural and synthetic rubbers, the author deals with polyethylene, PVC, PVDC, PVA and the polyurethanes. Also discussed are the identification of compounding ingredients used in these polymers. This thorough and useful work will unquestionably become a standard and is a must for all interested in the analysis of rubber and rubber-like polymers. 250 pages.

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ess. A subject which receives particular attention is atmospheric pollution both by sulfur compounds and by dust.

A number of charts, tables and diagrams illustrate the operation and degree of efficiency of the up-to-date equipment discussed. Each chapter concludes with a useful list of relevant companies and their addresses. It is regrettable that most of these, as well as the literature references, were restricted to English sources. Chemical engineers eager to keep abreast of the most recent developments in such techiques as electro-precipitation will nonetheless find this a clear and comprehensive guide to an extremely broad and complex subject.

BOOKLETS, CATALOGS, etc.

Questions & Answers on Electron Microscopes. Philips Electronics, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y. 5½ x 8½ in. 12 pp.

This booklet was compiled from queries asked in the field and in microscope courses concerning the functioning of two instruments, Models EM-75B and EM-100B electron microscopes. Magnification, resolution, specimen preparation and fields of application are discussed in 46 questions and answers. Shadow casting, electron diffraction, camera work, stereo technique, astigmatism correction, lens detail, beam wobbler, through-focus control and many other technical matters are also covered.

•

Motoreducers by Falk. (Bulletin 3100). The Falk Corporation, Milwaukee, Wisc. 8½ x 11 in. 28 pp.

A complete line of motor reducing drives are described in this richly illustrated catalogue. A guide to the selection of drives with the most convenient output shaft position, load classification and unit size, is followed by a section on low speed shaft connections, facilitating proper choice of couplings. Two tables present thrust capacity information for standard single-ended shafts with pure thrust loads. Dimensions and weights are supplied for basic equipment as well as accessories.

•

Integral-Shaft Vari-Pitch Sheaves. (Bulletin 20B7897B). Allis-Chalmers Mfg. Co., Milwaukee 1, Wisc. 8½ x 11 in. 6 pp.

Construction and operating features of integral shaft sheaves for stepless speed control in large machine drives are given in this bulletin. The sheaves provide a wide range of speeds, infinite speed variations and accurate speed controls while the drive is in motion. The bulletin announces that they are available with lubrication systems engineered to assure distribution of lubricants to all moving parts. Five charts supply dimensions and specifications for sprocket adjustment types.

•

Data Processing Equipment. (Preliminary Technical Publication N-O7 [1]). Leeds & Northrup Co., Philadelphia 44, Penna. 8½ x 11 in. 48 pp.

This publication describes data processing equipment in use at a number of plants and defense installations, with a photograph of each unit. Digital data processing and analog and digital computing systems are covered. Types of inputs, input switching, output devices and modes of operation are presented for applications in electric power, petrochemical, aeronautics, agriculture and other fields. A good introduction to a complex subject.

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The non-staining properties of Polysar* Krynac (nitrile) rubbers have been markedly improved and the raw polymer colour has been lightened. These improvements, together with the inherent advantages of easy processing and relatively low water absorption, provide the best balance of properties in oil resistant rubbers.

Polymer Corporation Limited has been producing Polysar Krynac . . . "cold" nitrile rubber . . . since 1949. This production experience is unmatched by any other supplier. The current program of polymer improvement emphasizes their leadership in the field.

Many applications requiring varying degrees of oil resistance have been launched by the adoption of one of the Polysar Krynac types. In the past these have usually been black compounds. More recently compounders have turned to Polysar Krynac as the base polymer for coloured compounds —notably in the development of oil and heat resistant industrial shoe soling and smooth, flame-resistant cable jackets. In both black and coloured compounds Polysar Krynac has improved the product quality and reduced production costs.

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POLYSAR Krynacs

POLYMER CORPORATION LIMITED
SARNIA, CANADA

See overleaf for striking results of comparison tests under sun-lamp exposure.

Tests prove the definite superiority of improved Polysar Krynacs

Per Cent Yellowness of Oil Resistant Rubbers				
Rubber	Staining (Lacquer exposed)		Discolouration (Rubber exposed)	
	Absolute	Relative	Absolute	Relative
Original Polysar Krynac 800	**36.0**	**100**	**75.9**	**100**
Competitive nitrile rubber "A"	52.6	146	76.8	101
Competitive nitrile rubber "B"	52.2	145	83.8	110
Competitive nitrile rubber "C" most recently announced	**31.6**	**88**	**74.5**	**98**
IMPROVED KRYNAC SERIES	**19.2**	**53**	**68.2**	**90**

The yellowness figures in the above chart were determined by testing improved Polysar Krynacs along with original Polysar Krynac 800 and three competitive nitrile rubbers in a simple white compound.

$$\text{Relative Yellowness} = \frac{\text{Yellowness of Rubber}}{\text{Yellowness of Krynac 800}} \times 100$$

They show:

1. The superiority of the original Polysar Krynacs 800, 801, 802 and 803 over two standard competitive grades in discolouration and staining after sun-lamp exposure.

2. The striking improvement of the current Polysar Krynac series in discolouration and staining under sun-lamp exposure, not only over the original Polysar Krynac 800-3 series, but also over the most recently announced competitive nitrile rubber.

3. The reduction of yellowing of adjacent light coloured finishes to one-half of that experienced with the original Polysar Krynac series; to one-third of yellowing caused by standard competitive grades, or by almost one-third over the newest competitive grade.

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for full information about the new Polysar Krynacs.

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MARKET REPORTS

TRENDS
NEWS
PRICES

Natural Rubber

Since our last report (January 4), the price of spot rubber on the New York Commodity Exchange has moved in a range of 325 joints, high for the period being 43.50c reached on January 5, and low being 40.25c reached on January 21 and 29. The average price of spot rubber for the month of January was 41.18c based on 20 trading days. This compares with an average of 41.46c in the previous month.

The International Rubber Study Group estimates that 2,085,000 long tons of natural rubber were consumed in the world in 1959. It also estimates that 2,020,000 long tons of natural rubber were produced in 1959, for an estimated deficit of 65,000 long tons.

On this latter point it should be noted that the total amount of natural rubber available from usual sources for consumption in 1959 was augmented by the quantity sold from government stocks for delivery up to December 31, 1959. While the governments of the United States and the United Kingdom are making public details of the sales, no final figure as to the amounts which went into 1959 consumption are presently available. It may be that when all the figures are in, the supply-demand picture for 1959 will be just about in balance.

U. S. Production-Consumption

It is now estimated that just about 570,000 long tons of natural rubber (dry and latex) were imported into the United States in 1959 of which some 20,000 long tons were re-exported leaving a total net new supply of 550,000 long tons. It is believed that 555,000 long tons of natural rubber were consumed in the United States in 1959. Stocks at the end of 1959 were estimated to be in the order of 79,475 long tons.

Over-all consumption in 1960 is expected to be in the order of 1.65 million long tons. If natural rubber accounts for the 556,000 long tons now estimated, the percentage held by natural rubber to total new rubber consumption will be approximately 33.7 per cent. Thus, natural's share will be about the same in 1960 as it was in 1959.

At this point, no one knows precisely what quantities of natural rubber will be made available from the natural rubber stockpile in 1960. The statistical picture may be altered to some degree if quantities larger than now expected were to be made available.

The pressures which will exist through 1960 are now unknown, as are matters involving Soviet purchases and the political state of affairs in rubber producing areas. Suffice it to say that at this point it looks as if natural rubber will certainly do no worse in 1960 than in 1959.

NEW YORK, FEBRUARY 1, 1960

Price Data

Closing Rubber Prices on New York Commodity Exchange

FROM JAN. 1 TO JAN. 31

Jan.	Spot	Mar.	May	July	Sales
1	....	....	....	....	...
2	....	....	....	....	...
3	....	....	....	....	...
4	42.00	39.75	38.20	37.15	27
5	43.50	40.80	39.35	38.45	154
6	42.75	40.17	38.90	38.00	88
7	42.75	40.55	39.25	38.25	41
8	41.50	39.85	38.70	37.75	73
9	....	....	....	....	...
10	....	....	....	....	...
11	41.38	39.70	38.70	37.60	16
12	41.50	40.05	39.00	38.00	46
13	41.25	39.55	38.65	37.80	93
14	40.50	39.25	38.40	37.50	136
15	40.75	39.70	38.80	37.90	63
16	....	....	....	....	...
17	....	....	....	....	...
18	41.00	39.90	39.00	38.15	46
19	41.13	40.15	39.25	38.70	50
20	40.63	39.85	39.00	38.50	102
21	40.25	39.60	38.65	38.15	82
22	40.50	39.96	39.10	38.25	38
23	....	....	....	....	...
24	....	....	....	....	...
25	40.50	40.03	39.25	38.50	17
26	40.38	40.00	39.15	38.60	63
27	40.63	40.62	39.85	39.18	99
28	40.50	40.30	39.60	38.85	27
29	40.25	40.05	39.35	38.65	53
30	....	....	....	....	...
31	....	....	....	....	...

Outside Market

No. 1 Ribbed Smoked Sheets:	
Spot	.40¼
Mar.	.40⅛
Apr.-June	.39⅝
Thin Latex Crepe:	
Spot	.46
Thin Brown Crepe, No. 2	.40¼
Flat Bark Crepe	.36½

London Market
(Standard Smoked Sheets)

Mar.	40.14 — 40.43
Apr.-June	38.83 — 38.97

Singapore Market
(Standard Smoked Sheets)

Mar.	37.81 — 37.89

Middling Upland Quotation

	Dec. 31	January 29		
	Close	High	Low	Close
Mar.	33.08	33.13	33.11	33.12
May	33.26	33.23	33.22	33.23
July	33.21	32.80	32.78	32.80

Notes & Quotes

According to J. P. Seiberling, president of the Seiberling Rubber Co., a particularly bright spot for the rubber industry in 1960 will be in the sale of tire retreading materials. "In 1960, this market should increase about six per cent above the 515 million pounds sold in 1959. But in the next four years we expect retread sales to rise at least 30 per cent from present levels." Mr. Seiberling notes that sales of new and used cars will be high in 1960 and that there will be a record number of cars on the road.

Synthetic Rubber

While final adjusted figures are not yet available, it appears as if 1,060,000 long tons of synthetic rubber of all types were consumed in the United States in 1959 against the 879,912 long tons consumed in the previous year. It is now expected that 1,094,000 long tons of synthetic rubber will be consumed in 1960 of a total predicted new rubber consumption of 1.65 million long tons.

Every segment of the synthetic rubber industry including S-type, butyl, neoprene and N-type recorded substantial gains in 1959. Final figures should indicate that approximately 886,000 long tons of S-type were consumed in 1959; 65,000 long tons of butyl rubber: 85,000 long tons of neoprene, and 35,000 long tons of N-type rubber.

The International Rubber Study Group estimates that a total of 1,527,000 long tons of synthetic rubber were consumed in the world in 1959 (not including Soviet Bloc consumption). This means that in 1959 something in excess of 465,000 long tons of synthetic rubber were consumed by Free World countries in the past year. Of this total, the United Kingdom accounted for approximately 79,000 long tons, followed by West Germany with 65,000 long tons and France with 63,000 long tons.

Exports of synthetic rubber to Free World nations in 1959 totaled approximately 280,000 long tons. It has been suggested that the growing capacity of Free World countries outside the United States to produce synthetic rubber will materially cut U. S. exports in 1960, 1961 and the years that follow.

Export Markets

It has been estimated that by 1962, world demand for synthetic rubber will be in the order of 3 million long tons annually. Of this sum, the U.S. will be able to satisfy requirements for about 1.75 million long tons, leaving 1.25 million long tons.

It is estimated that Soviet production will be able to take care of about one-half of the 1.25 million long tons, and Free World capacity (outside the U.S.), the other half. If the United States, for example, consumes about 1.2 million long tons of synthetic rubber in 1962, it will have, at that time, an excess of capacity over consumption of approximately 550,000 long tons.

Further, if U.S. exports drop because of increases in foreign production, what will happen to the 550,000 long tons which can be produced? Will production be cut back, or will greater quantities of synthetic be consumed in the U.S. than the figures now seem to suggest? Indeed, all is not cut and dried in the rubber industry!

PRICES OF COMMERCIALLY AVAILABLE

Dry Rubber

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene NF	.4900
Butaprene NH	.6500
Butaprene NL	.5000
Butaprene NXM	.5800
Chemigum N1NS	.6400
Chemigum N3NS and N5	.5800
Chemigum N6	.5000
Chemigum N6B	.5000
Chemigum N7	.5000
Chemigum N8	.5000
Chemigum N600	.5000
Herecol N-33	.6800
Hycar 1001 and 1041	.5800
Hycar 1002	.5000
Hycar 1014	.6000
Hycar 1042 and 1043	.5000
Hycar 1051	.5800
Hycar 1052	.5000
Hycar 1053	.5000
Hycar 1072	.6400
Hycar 1203	.4600
Hycar 1312	.5000
Hycar 1411	.6200
Hycar 1432	.5900
Hycar 1441	.6200
Paracril AJ	.4850
Paracril B and BJ	.5000
Paracril BLT and BJLT	.5000
Paracril C and CLT	.5800
Paracril CV	.5900
Paracril D	.6500
Paracril 18-80	.6000
Paracril OZO	.4600
Polysar Krynac 800	.5000
Polysar Krynac 801	.5800
Polysar Krynac 802	.5000
Polysar Krynac 803	.5000

Butadiene-Styrene Types

Ameripol 1000	.2410
Ameripol 1001	.2410
Ameripol 1002	.2435
Ameripol 1006	.2410
Ameripol 1006 (crumb)	.2475
Ameripol 1007	.2410
Ameripol 1009	.2475
Ameripol 1009 (crumb)	.2590
Ameripol 1011	.2475
Ameripol 1012	.2425
Ameripol 1012 (crumb)	.2490
Ameripol 1013	.2410
Ameripol 1013 (crumb)	.2615
Ameripol 1500 and 1501	.2410
Ameripol 1502	.2410
Ameripol 1703	.2060
Ameripol 1705	.2035
Ameripol 1707	.1910
Ameripol 1708	.1910
Ameripol 1710	.1885
Ameripol 1712	.1885
Ameripol 1805	.1550
Ameripol 4600	.2410
Ameripol 4650	.1820
Ameripol 4651	.1770
Ameripol 4652	.1425
Ameripol 4654	.1870
Ameripol 4655	.1820
Ameripol 4700	.1750
Ameripol 4750	.1545
Ameripol 4751	.1400
Ameripol 4752	.1600
Ameripol 4753	.1480
ASRC 1000	.2410
ASRC 1001 and 1004	.2410
ASRC 1006	.2410
ASRC 1009	.2475
ASRC 1018	.2700
ASRC 1019	.2650
ASRC 1500	.2410
ASRC 1502	.2410
ASRC 1503	.2625
ASRC 1703	.2060
ASRC 1708	.1910
ASRC 1712	.1885
ASRC 1713	.1750
TSRC 3105 and 3106	.2410
ASRC 3110	.2600
Baytown 1600	.1930
Baytown 1601	.1930
Baytown 1602	.1930
Baytown 1801	.1760
Baytown 1803	.1740
C-102 (Shell)	.2300
Carbomix 3750	.1820
Carbomix 3751	.1545
Carbomix 3752	.1845
Carbomix 3753	.1640
Carbomix 3756	.1569
Carbomix 3757	.1480
Carbomix 3758	.1545
Carbomix 3760	.1496
CB-102 (Shell)	.1850
Copo 1500	.2410
Copo 1502	.2410
Copo 1505-NS	.2610
Copo 1712	.1885
Copo 1773	.2060
Copo 1778	.1910
Copo 3700	.1725
Copo 3701	.1750
Copo 3900	.2310
FR-S 146	.2410
FR-S 158	.3000
FR-S 173	.2060
FR-S 178	.1910
FR-S 181	.2410
FR-S 182	.2410
FR-S 184	.1885
FR-S 1000	.2410
FR-S 1001	.1410
FR-S 1004	.2410
FR-S 1006	.2410
FR-S 1007	.2410
FR-S 1009	.2475
FR-S 1010	.2600
FR-S 1012	.2425
FR-S 1013	.2410
FR-S 1014	.2810
FR-S 1500	.2410
FR-S 1502	.2410
FR-S 1703	.2060
FR-S 1710	.1885
FR-S 1712	.1885
Gentro 1500	.2410
Gentro 1712	.1885
Gentro-Jet 9152	.2080
Gentro-Jet 9153	.1820
Gentro-Jet 9154	.1845
Gentro-Jet 9250	.1580
Gentro-Jet 9251	.1640
Gentro-Jet 9252	.1670
Gentro-Jet 9275	.1500
Naugapol 1016	.2650
Naugapol 1018	.2700
Naugapol 1019	.2650
Naugapol 1022	.2950
Naugapol 1023	.3150
Naugapol 1503	.2625
Naugapol 1504	.0330
Naugapol 6003	.2700
Naugapol 6100	.3100
OB-102 (Shell)	.1825
OB-104 (Shell)	.1475
OB-106 (Shell)	.1510
OB-110 (Shell)	.1410
OB-111 (Shell)	.1540
OB-113C (Shell)	.1750
OB-114C (Shell)	.1420
Philprene 1000	.2410
Philprene 1001	.2410
Philprene 1006	.2410
Philprene 1009	.2475
Philprene 1018	.2700
Philprene 1019	.2650
Philprene 1500	.2410
Philprene 1502	.2410
Philprene 1503	.2625
Philprene 1601	.1930
Philprene 1603	.1960
Philprene 1605	.1900
Philprene 1703	.2060
Philprene 1708	.1910
Philprene 1712	.1885
Philprene 1803	.1740
Philprene 1805	.1550
Plioflex 1006	.2410
Plioflex 1500C	.2410
Plioflex 1502	.2410
Plioflex 1507	.2410
Plioflex 1508	.2410
Plioflex 1710C	.1885
Plioflex 1712C	.1885
Plioflex 1713	.1750
Plioflex 1714C	.1725
Plioflex 1773	.2060
Plioflex 1778	.1910
Polysar Kryflex 200	.2510
Polysar Krylene	.2410
Polysar Krylene NS	.2410
Polysar Krynol 651	.1885
Polysar Krynol 652	.1910
Polysar S	.2410
Polysar S-50	.2410
Polysar S-X 371	.2550
Polysar SS-250	.2875
S-1000	.2300
S-1002	.2325
S-1006	.2300
S-1009	.2400
S-1011	.2325
S-1013	.2300
S-1500	.2300
S-1502	.2300
S-1509	.2300
S-1600	.1825
S-1602	.1825
S-1605	.1800
S-1703	.1950
S-1707	.1800
S-1709	.1775
S-1710	.1775
S-1712	.1775
S-1803	.1650
S-1804	.1750
S-7701	.1850
SP-103 (Shell)	.2900
Synpol 1000	.2410
Synpol 1001	.2410
Synpol 1002	.2435
Synpol 1006	.2410
Synpol 1007	.2410
Synpol 1009	.2475
Synpol 1012	.2425
Synpol 1061	.2410
Synpol 1500	.2410
Synpol 1502	.2410
Synpol 1551	.2410
Synpol 1703	.2060
Synpol 1707	.1910
Synpol 1708	.1910
Synpol 1711	.1900
Synpol 1712	.1885
Synpol 8000	.2410
Synpol 8150	.1930
Synpol 8200	.1910
Synpol 8201	.1750
Synpol 8250	.1740
Synpol 8253	.1584
Synpol 8254	.1545
Synpol X-274	.2550

Butyl Rubbers

Enjay Butyl 035 and 150	.2300
Enjay Butyl 165 NS	.2400
Enjay Butyl 215	.2300
Enjay Butyl 217	.2300
Enjay Butyl 218	.2300
Enjay Butyl 268 NS	.2400
Enjay Butyl 325	.2300
Enjay Butyl 365 NS	.2400
Polysar Butyl 100	.2450
Polysar Butyl 101	.2775
Polysar Butyl 200 and 300	.2450
Polysar Butyl 301	.2550
Polysar Butyl 400	.2450

Chlorosulfonated Polyethylene

Hypalon 20	.7000
Hypalon 30	.7000

Fluoroelastomers

Kel-F Fluorel	$15.00
Kel-F 3700	$16.00
Kel-F 5500	$16.00
Viton A	$10.00
Viton A-HV	$10.00
Viton B	$13.00

Neoprene

	(prices l.c.l.)
Neoprene Types AC and CG	.5500
Neoprene Type AD	.5500
Neoprene Type FB	.6500
Neoprene Type GN	.4100
Neoprene Type GN-A	.4100
Neoprene Type GRT	.4200
Neoprene Type KNR	.7500
Neoprene Type S	.4200
Neoprene Type W	.3900
Neoprene Type WB	.4100
Neoprene Type WHV	.3900
Neoprene Type WRT	.4500
Neoprene Type WX	.4100

Polysulfide Rubbers

	(prices l.c.l.)
Thiokol Type A	.5000
Thiokol Type FA	.6900
Thiokol Type ST	1.2500

Silicone Rubbers*

	(prices l.c.l.)
GE (compounded)	2.50
GE Silicone Gum (not compounded)	4.00
Silastic (compounded)	2.50
Silastic (gums)	4.00
Union Carbide (gums)	4.00
Union Carbide (compounds)	2.50

SYNTHETIC RUBBER POLYMERS

Latex

(per pound carload)

Butadiene-Acrylonitrile Types

Butaprene N-300	.4600 [3]
Butaprene N-400 and N-401	.5400 [1]
Chemigum 200	.4900 [3]
Chemigum 235 and 236	.5400 [3]
Chemigum 245	.4600 [3]
Chemigum 246	.4600 [3]
Chemigum 247	.4600 [3]
Chemigum 248	.4600 [3]
Hycar 1512	.4500 [3]
Hycar 1551	.5300 [3]
Hycar 1552	.4500 [3]
Hycar 1561	.5300 [3]
Hycar 1562	.4500 [3]
Hycar 1571	.5300 [3]
Hycar 1572	.4500 [3]
Hycar 1577	.4500 [3]
Tylac 640	.4500 [1]
Tylac 740	.4900 [1]
Tylac 840	.5300 [1]
Tylac 1640	.5400 [1]
Tylac 2241	.5300 [1]
Tylac 2430	.5000 [1]
Tylac 2570	.5300 [1]
Tylac 2830	.4500 [1]

Butadiene-Styrene Types

CL-101 (Shell)	.2800 [3]
Copo 2000	.2775 [3]
Copo 2101	.3000 [3]
Copo 2102	.3200 [3]
Copo 2105	.3200 [3]
Copo 2108	.3000 [3]
Copo 2109	.2775 [3]
Copo 2110	.3200 [3]
Copo 3852	.2900 [3]
FR-S 110	.3000 [3]
FR-S 150	.3000 [3]
FR-S 151	.2900 [3]
FR-S 174	.2950 [3]
FR-S 176	.2775 [3]
FR-S 2000	.2775 [3]
FR-S 2001	.2775 [3]
FR-S 2002	.3000 [3]
FR-S 2003	.3050 [3]
FR-S 2004	.3050 [3]
FR-S 2006	.2900 [3]
FR-S 2105	.3200 [3]
Naugatex 2000	.2775 [1]
Naugatex 2001	.2775 [1]
Naugatex 2002	.3000 [1]
Naugatex 2006	.2900 [1]
Naugatex 2105	.3200 [1]
Naugatex 2107	.3200 [1]
Naugatex 2108	.3000 [1]
Naugatex 2113	.2900 [1]
Naugatex J-8174	.3200 [1]
Naugatex J-8535	.3000 [1]
Nitrex 2612	.5000 [1]
Nitrex 2614	.4600 [1]
Nitrex 2614-A	.4600 [1]
Nitrex 2615	.5100 [1]
Nitrex 2615-A	.5100 [1]
Nitrex 2616	.5800 [1]
Nitrex 2617	.4600 [1]
Nitrex 2617-A	.4600 [1]
Nitrex 2619	.5700 [1]
Nitrex 2620	.5000 [1]
Nitrex 2625	.5000 [1]
Nitrex 2625-A	.5000 [1]
Nitrex J-6849	.5400 [1]
Pliolite 2000	.2775 [3]
Pliolite 2001	.2775 [3]
Pliolite 2076	.2900 [3]
Pliolite 2104	.3200 [3]
Pliolite 2105	.3200 [3]
Pliolite 2107	.3200 [3]
Pliolite 2108	.3000 [3]
S-2000 and S-2006	.2600 [3]
S-2101	.2600 [3]
S-2105	.2800 [3]
S-2108	.2900 [3]

Neoprene

Neoprene Latex 60	.4000 [3]
Neoprene Latex 571	.3700 [3]
Neoprene Latex 572	.3900 [3]
Neoprene Latex 601-A	.4000 [3]
Neoprene Latex 673	.5000 [3]
Neoprene Latex 735	.3800 [3]
Neoprene Latex 736	.3800 [3]
Neoprene Latex 842-A	.3700 [3]
Neoprene Latex 950	.4700 [3]

Polysulfide Rubbers

Thiokol Type MX	.8000 [3]
Thiokol Type WD-2	1.2500 [3]
Thiokol Type WD-6	.8000 [3]

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

PROBLEM: *How can processing synthetic polymers and crude rubber be improved to attain FULL PRODUCT QUALITY?*

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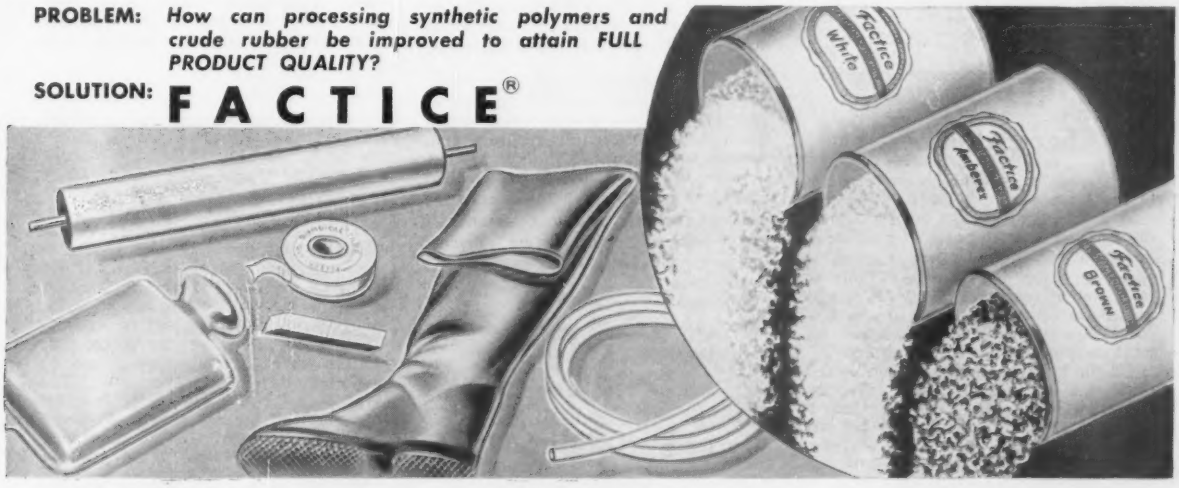

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Stamford, Conn.

MARKETS

(continued)

Reclaimed Rubber

On the basis of figures available to date, it appears as if some 305,000 long tons of reclaimed rubber were produced in the United States in 1959 against the 259,578 long tons produced in the previous year. 1959 thus becomes the best year the reclaimed rubber industry has enjoyed since 1955, when 325,914 long tons were produced.

Consumption of reclaimed rubber in 1959 in the United States was in the order of 288,000 long tons, about 40,000 long tons more than in the previous year. The last time reclaimed rubber consumption in the United States topped 300,000 long tons was in 1955 when 312,781 long tons were consumed.

The feeling in the industry is that 1960 will be even a better year with consumption at or near a 300,000 long ton level.

(Prices for All Areas Except Calif.)

	per lb.
Premium Grade Whole Tire	.11½
First Line Whole Tire	.11
Second Line Whole Tire	.10½
Third Line Whole Tire	.10¼
Fourth Line Whole Tire	.09¾
Black Carcass	.15¼
No. 1 Light Colored Carcass	.22
No. 1 Peel	.11
Butyl Tube Reclaim	.14
Natural Rubber Black Tube	.16
Natural Rubber Red Tube	.21
Natural Rubber Gray Tube	.21

Scrap Rubber

Moderate activity has been reported in the scrap rubber market during the past few weeks although dealers are of the opinion that there is a good deal of room for improvement. Generally speaking, scrap dealers expect 1960 to be a better year than 1959. It is expected, however, that the growing use of plastics will have an effect upon the total consumption of scrap rubber.

On the basis of current figures, something like 300,000 long tons of scrap rubber were consumed in the United States in 1959. Most dealers believe that scrap rubber consumption in 1960 will top the 1959 figure—if only by a small amount.

The major dissatisfaction at the moment, has to do with prices. It is not expected that prices will be adjusted by any considerable degree in 1960.

(Prices Delivered Akron)

Mixed tires	ton	15.00
Light colored carcass	lb.	.05
No. 1 peelings	ton	40.00
No. 2 peelings	ton	28.00
No. 3 peelings	ton	23.00
Buffings	ton	16.00
Truck and Bus S.A.G.	ton	22.00
Passenger S.A.G.	ton	20.00
Natural Rubber Red Tubes	lb.	.07½
Natural Rubber Black Tubes	lb.	.06½
Butyl Rubber Tubes	lb.	.07½

Tire Fabrics

Celanese Corp. of America hopes to have Darvan, its newly acquired textile fiber, in full production within a year. New facilities to produce the synthetic fiber are soon to be installed at the company's Pampa, Texas, plant. Announcement of the company's plans follows on the news of its acquisition of Darvan from the B. F. Goodrich Co.

Celanese acquired the patents, trademarks, technical know-how and world rights to produce and market the fiber, while Goodrich retained the rights for non-textile uses. Terms of the transaction were not disclosed.

Goodrich, developer of the material, is reported to have invested about $15 million in the project. Included are costs of research and operation of a 500,000 pound plant at Avon Lake, Ohio.

Goodrich says its plant will continue in production until Celanese has its own facilities on stream at Pampa. Goodrich has also indicated that it is still interested in developing other applications for the fiber.

Celanese foresees a market potential of 36 to 40 million pounds yearly for the fiber. Though similar in many respects to other fibers now on the market, Darvan is reported to have several superior characteristics.

Tripling Nylon-6 Output

Allied Chemical Corp. has announced plans to triple its annual productive capacity for nylon-6 yarn. It is expected that the move will intensify the battle which has developed among yarn makers to provide the cord which goes into the original equipment market.

Industry observers estimate Allied Chemical's Current nylon-6 capacity at 25 million pounds a year which would mean the expansion calls for an annual capacity of around 75 million pounds.

In addition to its use to tires, Allied Chemical states that nylon-6 is being used in growing volume by manufacturers of conveyor belting, marine hawsers, coated tarpaulins, etc.

(Prices f.o.b. Shipping Point)

Rayon Tire Cord

1100	lb.	.62½
1650	lb.	.62
2200	lb.	.62½

Nylon Tire Cord

210	lb.	1.75
840	lb.	1.47

Rayon Graded Fabric

1100	lb.	.69
1650	lb.	.63½
2200	lb.	.63

Cotton Chafers

8.9 oz. (per square yard)	lb.	.74
9.25 oz. (per square yard)	lb.	.71
11.65 oz. (per square yard)	lb.	.65
14.4 oz. (per square yard)	lb.	.74

Liquid Latex

Natural: Consumption of natural latex in the United States in 1959 is estimated to be in the neighborhood of 72,000 long tons, compared with the 70,183 long tons consumed in the previous year. The natural latex segment, it is felt, enjoyed rather a good year notwithstanding the fact that through most of the year prices were relatively high. At the moment, natural latex prices are in a range of 48 to 50c in car load lots at East Coast ports.

The trade believes that the quantity of natural rubber latex which will be consumed in 1960 largely hinges on the question of price. It is known that more natural latex is used when prices range between 30 and 40c than when prices range between 40 and 50c. It is the feeling in the trade that natural latex will feel competition from synthetic latices even more keenly in 1960 than in 1959.

Synthetic: While final adjusted figures are not yet available, it now appears as if consumption of synthetic latex of all types in 1959 was near a 105,000 long ton level. This is just about 25,000 long tons more than consumed in the previous year and is the highest consumption total ever.

All types of synthetic latex did well in 1959. S-type latex accounted for about 80,000 long tons of the consumption total, while neoprene latex accounted for about 11,500 long tons. Consumption of nitrile latices in 1959 was approximately 13,500 long tons.

In every case, each type of synthetic latex established new consumption records. What with estimates for increased new rubber consumption in 1960, the synthetic latices should continue to do well.

Cotton

The price of middling uplands on the New York Cotton Exchange moved in the extremely narrow range of 10 points since our last report (January 4), high for the period being 33.15c reached on January 4 and on January 28 and 29. Low for the period was 33.05c reached on January 5 and on five other days during the month. The average price of middling uplands for the month of January was 33.09c based on 20 trading days. This compares with an average of 33.02c in the previous month.

The U. S. Department of Agriculture reports that the supply of all kinds of cotton in the United States in the August-December, 1959, period totaled 23,200,000 bales compared with the 19,800,000 bales in the same period of 1958 and 21,100,000 bales in 1957. Disappearance is estimated at 6,000,000 bales against 4,700,000 bales a year earlier.

Stocks of cotton owned or held as collateral for loans by the Commodity Credit Corp. as of January 1, 1960, are estimated at 6,800,000 bales. On January 1, 1959, stocks totaled 6,700,000 bales.

Call Hall

HALLCO NEWS

Issued by
The C. P. Hall Co.
Chemical Manufacturers

No. 9

HALLCO C-556 PLASTICIZER CUTS MIXING TIME OF NATURAL OR SYNTHETIC RUBBERS

When used in the processing of rubber, Hallco C-566 greatly reduces mixing time by speeding up dispersion of carbon black or other fillers. It also gives excellent scorch protection, often more than doubling scorch resistance time. Hallco C-566 has no measurable effect on the hardness of finished products. This economical plasticizer minimizes shrinkage in calendered stock and imparts superior smoothness to extrusions. It gives outstanding results when used for camelback, molded goods, channel stocks, cement stocks and all extruded items. Charts below show its unusual properties in our tests. Hallco C-566 is manufactured by The C. P. Hall Company and is available in drums or tank cars.

Stock Containing C-566:

	Without C-566 A	With C-566 B
Smoked Sheet	100	
Zinc Oxide	4	
Stearic Acid	0.5	
EPC Black	25	
FEF BLACK	25	
Ultex	0.75	
Sulphur	2.75	
C-566	....	7.5
	158	165.5

Mooney Scorch SR @ 250° F.

Minutes to 3-point rise	5.25	8.0
Minutes to 5-point rise	5.75	8.5
Minutes to 10-point rise	6.25	11.0

Samples and data on Hallco C-566 are available on request. Order yours today!

Be Accurate: Call it PARA-FLUX® only if it came from The C. P. Hall Company

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MARKET PRICES

CHEMICALS & COMPOUNDING INGREDIENTS

FEBRUARY 1, 1960

Prices are, in general, f.o.b. works and cover the domestic markets only. Export prices, as a rule, are usually slightly higher, due to packing regulations, special handling, etc.

Abbreviations: bbls., barrels; c.l., carload; cyl., cylinder; dlvd., delivered; dms., drums; eqld., equalized; l.c.l., less than carload; M.B. masterbatch; min., minimum; ref., refined; sap., saponified; sp., special; syn., synthetic; t.c., tank cars.

*Trademark. †For Export Only.

The arrangement of this section closely follows the Chemical Section of the 1959 RUBBER RED BOOK. Readers are referred to that edition for the correct classification of any material or brand name. Suppliers of every material are contacted for price information. However, only those materials are listed for which quotations have been furnished within the past six months. The quotations are not guaranteed and prospective purchasers should contact suppliers for information. Suppliers are requested to send current price information to the Market Editor, RUBBER AGE.

ACCELERATORS

A-1 (Thiocarbanilide)*	lb.	.74	.81
A-32*	lb.	.66	.80
A-100*	lb.	.52	.66
Accelerator No. 8*	lb.	—	1.25
Accelerator—49*	lb.	.59	.60
Accelerator 108*	lb.	—	.92
Accelerator—552*	lb.	—	2.25
Accelerator—808*	lb.	.66	.68
Accelerator—833*	lb.	1.17	1.19
Accelerator B*	lb.	—	.92
Altax*	lb.	.54	.56
Amax*	lb.	.75	.77
No. 1*	lb.	.71	.73
Ancap*(†)	lb.	.38	.40
Ancatax*(†)	lb.	.48	.50
Ancazate BU (ET & ME)*(†)	lb.	—	1.07
Ancazide ET*(†)	lb.	—	1.07
ME*(†)	lb.	—	1.14
Arazate*	lb.	—	2.25
Arquad 12*	lb.	.55	.61
Beutene*	lb.	.66	.68
Bismate, Rodform*	lb.	—	3.00
Butazate 50D*	lb.	.87	.89
Butyl Eight*	lb.	1.10	1.35
Butyl Namate	lb.	.45	.50
Captax*	lb.	.44	.46
C-P-B*	lb.	—	1.95
Cumate, Rodform*	lb.	—	1.45
Cydac*	lb.	.71	.73
Delac S*	lb.	.71	.73
DIBS*	lb.	—	.85
Diorthotolyguanidine	lb.	.69	.70
Dipac*	lb.	—	.85
Diphenylguanidine	lb.	.49	.50
Dithiocarbamates			
Cyzate B & E	lb.	.85	.89
El-Sixty*	lb.	.62	.69
Ethazate*	lb.	—	1.04
50D*	lb.	.87	.89
Ethyl Thiurad*	lb.	—	1.04
Ethyl Tuex*	lb.	—	1.04
Ethylac*	lb.	.93	.95
Guantal*	lb.	.62	.69
Harvex*	lb.	.70	.76
Hepteen Base*	lb.	—	1.85
Kure-Blend MT*	lb.	—	.70
Ledate, Rodform*	lb.	—	1.04
MBT-XXX*	lb.	.55	.57
MBTS Grains*	lb.	.60	.62
Merac*	lb.	.75	1.05
Mercaptobenzothiazol	lb.	.44	.46
Mercaptobenzothiazyl Disulfide	lb.	.54	.56
Mertax*	lb.	.55	.62
Methazate*	lb.	—	1.04
Monex*	lb.	—	1.14
Mono Thiurad*	lb.	—	1.14
2-MT	lb.	.88	.90
NA-22* (for neoprene)	lb.	—	1.05
NOBS No. 1*	lb.	.71	.73
Special*	lb.	.75	.77
O-X-A-F	lb.	.55	.57
Pennac SDB*	lb.	.45	.48
Pentex*	lb.	—	1.24
Flour*	lb.	—	.30
Permalux (Neoprene)*	lb.	—	2.25
Phenex*	lb.	.60	.65
Polyac*	lb.	—	1.85
R-2 Crystals*	lb.	—	4.35
Rotax*	lb.	.55	.57
RZ-50-A* and B*	lb.	.70	1.00
Santocure*	lb.	.71	.73
NS*	lb.	.71	.73
26*	lb.	.75	.77
Selenac* (Ethyl, Methyl)	lb.	—	3.00
Seleram, Ethyl	lb.	—	3.00
Setsit-5*	lb.	.75	1.05
8*	lb.	.85	1.15
SPDX-GH*	lb.	.77	.79
GL*	lb.	1.20	1.30
Tellurac*	lb.	—	1.55
Tepidone*	lb.	.45	.45
Tetrone A*	lb.	—	1.98
Thiate A*	lb.	.88	—
B*	lb.	1.05	1.25
Thiazole ZMBT	lb.	.55	.57
Thiofide*	lb.	.54	.61
Thionex*	lb.	—	1.14
Thiotax*	lb.	.44	.51
Thiram, Ethyl	lb.	—	1.04
Methyl	lb.	—	1.14
Thiurad*	lb.	—	1.14
Thiuram E*	lb.	—	1.04
M*	lb.	—	1.14
Cyuram DS & MS	lb.	1.14	1.14
Trimene*	lb.	.56	.58
Base*	lb.	1.03	1.06
Triphenyl Guanidine	lb.	—	.90
Tuads* (Ethyl)	lb.	—	1.04
Tuads* (Methyl)	lb.	—	1.14
Tuex*	lb.	—	1.14
Ultex*	lb.	1.15	1.20
Unads*	lb.	—	1.14
Vulcacure NB*	lb.	.45	.45
NS*	lb.	.75	1.05
TMD*	lb.	—	1.14
ZB*, ZE*, ZM*	lb.	.85	.89
Z-B-X*	lb.	—	2.45
Zenite*	lb.	.54	.56
Zenite A*	lb.	.69	.71
Zenite AM*	lb.	.76	.78
Zenite Special*	lb.	.55	.57
Zetax* (uncoated)	lb.	.55	.57
Zimate* (Butyl)	lb.	—	1.04
Zimate* (Ethyl)	lb.	—	1.04
Zimate* (Methyl)	lb.	—	1.04
Zimate Slurry 50% solids content (Butyl, Ethyl & Methyl)	lb.	.85	.89
Ziram, Butyl	lb.	—	1.04
50% Dispersion	lb.	.85	.89
Ziram, Ethyl	lb.	—	1.04
50% Dispersion	lb.	.85	.89
Ziram, Methyl	lb.	—	1.04
50% Dispersion	lb.	.85	.89

ACTIVATORS

Blue Lead Sublimed	lb.	.17	.18
Cottonseed Fatty Acids			
Drew Wecoline C*	lb.	.17¾	.19
Wochem 210* and 211*	lb.	.16¾	.19¼
Fish Oil, Hydrogenated, Fatty Acid			
DAR-S* (dlvd.)	lb.	.12	.14½
DAR-HY* (dlvd.)	lb.	.15¼	.17¾
Hydrofol Acids* (dlvd.)	lb.	.15	.25¾
Hyfac 430* (dlvd.)	lb.	.18	.20½
Neo-Fat H.F.O.* (dlvd.)	lb.	.14½	.15¾
Neutrex* (dlvd.)	lb.	.14¼	.18¾
Stearite*	lb.	.11¾	.14¾
Talene*	lb.	.16¼	.18¾
Lime, Hydrated			
Arrowhead*	ton	—	21.00
Marblehead*	ton	—	19.25
Sierra*	ton	—	22.50
Litharge			
Eagle-Pitcher* (c.l.)	lb.	.13¾	—
SB* (dlvd.)	lb.	—	.18½
Magnesium Oxide, Heavy			
General Magnesite 500*	lb.	.05½	.06
600*	lb.	.06½	.07
Kaiser 325*	lb.	.03½	.06½
Michigan No. 15*	lb.	.05½	.06½

ACTIVATORS (Cont'd)

Magnesium Oxide, Light			
Carey Mag*	lb.	.25¼	.26
General Magnesite* (neoprene grade)	lb.	.26¼	.28¼
General Magnesite No. 101*	lb.	.23½	.24½
Genmeg MLW*	lb.	.23½	.24½
Light Calcined Magnesia			
No. X-01*	lb.	.25¼	.26
Maglite D*	lb.	.25¼	—
K*	lb.	.25¾	.27
L*	lb.	.29¾	.30¾
M*	lb.	.27	.28½
Marmag*	lb.	.24¾	.26
Michigan No. 30*	lb.	.24¼	.26½
Michigan 1782 Magnesia*	lb.	.25¼	.26½
Neomag Powder*	lb.	.29¼	.30
Pellets*	lb.	.31¾	.32
Oleic Acid			
Dar-Chem* 105	lb.	.16¼	.18¾
Drew Wecoline OO*	lb.	.17¾	.19
Emersol 210* (dlvd.)	lb.	.16¼	.18¾
Groco Red Oil	lb.	.16¼	.18¾
Neo-Fat 92-04*	lb.	.20½	.22½
94-04*	lb.	.18½	.20½
Wochem 310, 311	lb.	.16¼	.18¾
Palm Fatty Acids			
Groco 45*	lb.	.15¾	.18¾
Neo-Fat*	lb.	.15¾	.17¾
Wochem 280*	lb.	.15¾	.18¼
281*	lb.	.16¼	.18¾
Potassium Oleate (dms.)	lb.	.48	.73
Drew 24%*	lb.	.20	.73
Red Lead			
Eagle-Picher* (c.l.)	lb.	.14¼	—
No. 2 RM* (dlvd.)	lb.	—	.18½
Sodium Laurate, 75%*	lb.	.64	.89
Sodium Oleate, 75%*	lb.	.54	.79
Paste (dms.)	lb.	.39	.64
Sodium Stearate, 75%	lb.	.47	.72
Stearic Acid, Single Pressed			
Emersol 110* (dlvd.)	lb.	.15¼	.17¾
Groco 53*	lb.	.15¾	.18¼
Neo-Fat 18-53*	lb.	.14¾	.16¾
Dar-Chem 11*	lb.	.15¼	.17¾
Wochem 730*	lb.	.12¼	.14¾
Stearic Acid, Double Pressed			
Dar-Chem 12*	lb.	.15¾	.18¼
Emersol 12* (dlvd.)	lb.	.15¾	.18¼
Groco 54*	lb.	.15¾	.18¼
Hydrofol Acid 444	lb.	.12	.14½
Neo-Fat 18-54*	lb.	.15¼	.17¾
Wecoline 200*	lb.	.14¾	.16
1000*, 1500*	lb.	.12	.13¾
Wochem 731*	lb.	.14¾	.17¼
Stearic Acid, Other			
Extra Pearlstearic* (dlvd.)	lb.	.17½	.20
Groco 56*	lb.	.12	.14½
Neo-Fat 18*	lb.	.18½	.20½
18-58*	lb.	.14½	.16¾
18-61*	lb.	.16¼	.18¾
Stearex* (dlvd.)	lb.	.11¾	.13
Stearite*	lb.	.11¼	.13¾
Wecoline 300*	lb.	.15¼	.16½
Wochem 720*	lb.	.10¾	.13¼
721*	lb.	.10¾	.13¼
732*	lb.	.15¾	.18¼
White Lead Basic Carbonate	lb.	.18	.19
White Lead Basic Sulfate	lb.	.17	.18
Zinc Laurate			
Laurex*	lb.	.37	.39
Zinc Stearate	lb.	.41	.46
Aquazinc K.C.*	lb.	.30	.55
Crown Brand*	lb.	.39	.44

Unclassified Activators

Actifat* (dms.)	lb.	—	.18
Aktone*	lb.	.21¼	.23¼
Barak*	lb.	—	.65
Curade*	lb.	.57	.59
Dibenzo G-M-F	lb.	—	2.60
D-B-A*	lb.	—	1.95
G-M-F*	lb.	—	2.60
Dibutylamine (dlvd.)	lb.	.55½	.56¼
MODX*	lb.	.38	.40
Neo Fat 42-07*	lb.	.10¼	.12¾
Ridacto* (dms.)	lb.	.25	.26
Snodotte* (dlvd.)	lb.	.18½	.21
Vimbra	lb.	.32	.38½
Vulklor*	lb.	.88	.98

ANTI-COAGULANTS

Aqua Ammonia* (dms.)	lb.	.031	.035
M.B.M.C.* (l.c.l.)	lb.	.54	.76

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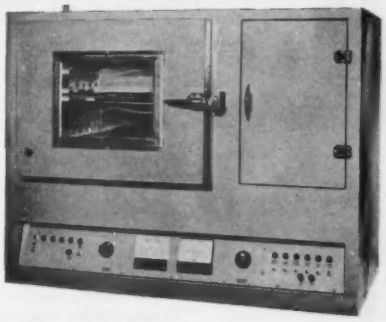
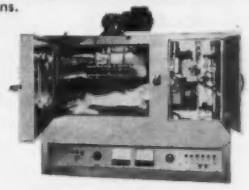
OREC 0300 *Automatically Controlled Ozone Test Chambers*

. . . certain factors associated with manual ozone measurement and control suggested the need for Automatically Controlled Ozone Test Chambers . . .



Orec 0300 Series employ an *electronic-chemical loop feed back servo system to achieve and precisely maintain chamber ozone concentrations.



Orec 0300 with Dynamic Stretching Apparatus.
*patent pending

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ANTI-FOAMING AGENTS

Aero Anti Foam H*	lb.	——	.20
Regular*	lb.	——	.12
Anhydrol 6991*	lb.	.51	.56
D.C. Antifoam A*	lb.	5.45	6.65
Antifoam A Emulsion*	lb.	2.05	2.85
Antifoam AF Emulsion*	lb.	2.05	2.85
Antifoam B*	lb.	.65	1.20
Defoama W-1701*	lb.	——	.12½
Defoamer A-25*	lb.	——	3.00
Defoamer 630*	lb.	——	.14
Deltyl Prime	lb.	.70	.80
Foamnix*	lb.	.60	1.50
G-E Antifoam SS-24*; 66*	lb.	5.28	6.65
60 Emulsion*		2.05	3.75
Igepol CO-210	lb.	——	.36
Kessco X-3* (dms.)	lb.	——	.39
X-180*	lb.	——	.28
X-181*	lb.	——	.36½
Nopco 1407*	lb.	.19½	.21½
1497-V*	lb.	.14¼	.16¼
1907-B*	lb.	.22½	.24½
JMK*	lb.	.48½	.50½
JMU*	lb.	.23¼	.25¼
JMY*	lb.	.21	.23
Pluronic L61*	lb.	.33½	.39
RS-968*	lb.	.38	.38½
Terpinol Prime No. 1	lb.	.35	.50
Tributyl Phosphate (dms.)	lb.	.52½	.53½
UC SAG 47*	lb.	4.85	6.25
470*	lb.	.61	1.10
VL-520*	lb.	2.68	3.50

ANTIOXIDANTS

Agebest 1293-22A*	lb.	1.90	2.00
AgeRite Alba*	lb.	2.40	2.50
Gel*	lb.	.70	.72
Hipar*	lb.	1.05	1.07
H.P.*	lb.	.79	.81
Powder*	lb.	.57	.59
Resin*	lb.	.88	.90
Resin D*	lb.	.57	.59
Spar*	lb.	.57	.59
Stalite & Stalite S*	lb.	.57	.59
Superflex*	lb.	.57	.59
Superlite*	lb.	.57	.59
White*	lb.	1.50	1.60
Akroflex C* Pellets	lb.	.85	.87
CD*	lb.	.79	.81
Aminox*	lb.	.57	.59
Antioxidant 425*	lb.	2.47	2.50
Antioxidant 2246*	lb.	1.50	1.53
Antox*	lb.	.59	.61
Aranox*	lb.	——	3.25
Benzoquinone	lb.	1.50	1.75
Betanox Special*	lb.	.94	.96
B-L-E*	lb.	.57	.59
Catalin CAO No. 1*	lb.	.57	.60
CAO No. 3*	lb.	.65	.68
CAO No. 5*	lb.	1.49	1.50
CAO No. 6*	lb.	——	3.50
Deenax*	lb.	.57	.60
Di-tert-Butyl-para-Cresol	lb.	.86	1.16
Eugenol C-95%*	lb.	2.30	2.50
Flectol H*	lb.	.57	.64
Flexamine*	lb.	.79	.81
Ionol*	lb.	.57	.60
Naugawhite*	lb.	.57	.59
Powder*	lb.	.57	.59
Neozone A*	lb.	.64	.66
C*	lb.	.86	.88
D*	lb.	.57	.59
Nevastain A*	lb.	.51	.61
B*	lb.	.51	.70
Nullapon BF-12*	lb.	——	.21½
BF-13*	lb.	——	.25½
BF-78*	lb.	——	.55
BF-Acid*	lb.	——	.85
Octamine*	lb.	.57	.59
Oxidex*	lb.	——	3.60
PDA-10*	lb.	.46	.48
Pennox* A, B, C, D	lb.	.57	.72
Permalux*	lb.	——	2.25
Polygard*	lb.	.57	.59
Santoflex AW*	lb.	.71	.78
DD*	lb.	.57	.64
75*	lb.	1.01	1.08
Santovar-A*	lb.	1.55	1.62
Santowhite Crystals*	lb.	1.55	1.62
Santowhite L*	lb.	.57	.64
MK*	lb.	1.25	1.32
Powder*	lb.	1.55	1.62
Sequestrene AA*	lb.	.70	.80
NA2*	lb.	.59	.66
NA3*	lb.	.58	.65
Stabilite*	lb.	.57	.59
Alba*	lb.	.75	.80
FLX*	lb.	.78	.80
L*	lb.	.65	.67
White*	lb.	.57	.59
White Powder*	lb.	.46	.48
Stabilizer No. 1*	lb.	1.55	1.80
Stabilizer No. 9-A*	lb.	.80	1.05
Styphen I*	lb.	.51	.55
Sunolite*	lb.	.16	.22
Tecquinol*	lb.	.82½	.84½
Tannic Acid, Tech.	lb.	.46	.48
Tenamene 3*	lb.	.57	.60
Thermoflex A*	lb.	1.05	1.07
Wing-Stay S*; T*	lb.	.56	.67
Zalba*	lb.	——	1.10
Special*	lb.	——	.85

ANTIOZONANTS

Eastozone* 32*	lb.	1.15	1.18
Flexzone 3C	lb.	——	2.00
6-H	lb.	1.25	1.27

ANTIOZONANTS (Cont'd)

Fura-Tone NC-1008*	lb.	.28	.39
NC-1012*	lb.	.46	.69
Santoflex AW*	lb.	.71	.78
UOP 88* & 288* (dms).	lb.	1.05	1.07
Wing-Stay 100*	lb.	1.00	1.08

ANTI-SCORCHING AGENTS

Akron Benzoic Acid	lb.	.41	.43
Armeen HT*	lb.	.34	.40
Good-rite Vultrol*	lb.	.67	.70
Harcopol 1183*	lb.	.70	.74
Retarder PD*	lb.	.37	.39
W*	lb.	——	.46
Sodium Acetate 60-62% Crystals	lb.	.08	.08½

ANTISEPTICS AND GERMICIDES

A.P.C. 6901*	lb.	.32	.38
Arquad S*	lb.	.38	.44
Formaldehyde (dms.)	lb.	.06	.076
G-4* (bbls.)	lb.	1.09	1.29
G-11*	lb.	1.98	2.08
Halane*	lb.	.40	.47
Ortho Cresol (26°—27°)	lb.	.14	.16¼
Preventol GD	lb.	——	1.09
Retarder D*	lb.	.42	.50

ANTI-WEBBING AGENTS (for Latex)

DC 7 Compound*	lb.	5.05	6.50
Webnix 34-L*	lb.	1.25	1.75
57*; 69C*	lb.	1.50	2.00
71*	lb.	1.25	1.75

AROMATICS (DEODORANTS)

Airkem 115*	gal.	——	6.50
122*; 186*	gal.	——	6.50
Alamask AA*	lb.	——	3.00
AF*	lb.	——	2.50
AO*	lb.	——	1.50
AR*	lb.	——	.50
BG*	lb.	——	1.15
BGM*	lb.	——	.60
CY*	lb.	——	2.40
DJ*	lb.	——	3.35
DL*	lb.	——	1.95
H*	lb.	——	5.50
LD*	lb.	——	.75
ND*	lb.	——	2.75
O*	lb.	——	6.50
OS*	lb.	——	5.25
Bouquet 149*	lb.	——	3.00
Coumarin*	lb.	——	3.70
Deodorant 65*	lb.	——	1.85
Deodorant L-37*	lb.	2.15	2.25
L-44*	lb.	2.65	2.75
N.L.T.X.*	lb.	1.90	2.00
Deodorant Oil GD 6422*	lb.	1.90	2.20
GD 6423*	lb.	1.60	1.90
GD 6575*	lb.	2.40	2.90
GD 31063*	lb.	2.25	2.75
Ethavan*	lb.	6.20	6.25
Latex Perfume 17326	lb.	——	4.00
18301	lb.	——	3.00
22258	lb.	——	2.50
Naugaromes* (dms.)	lb.	.60	3.00
Neutroleum Delta*	lb.	——	2.25
Gamma*	lb.	——	3.25
Parador A*	lb.	1.80	2.10
C*	lb.	2.00	2.50
E*	lb.	.25	.40
GD 5280*	lb.	2.00	2.50
GD 53481*	lb.	1.70	2.00
Perfume Oil Bouquet Vanilla M*	lb.	1.60	1.70
Rodo No. 0*	lb.	4.00	4.50
No. 10*	lb.	5.00	5.50
Rubbarome* (dms.)	lb.	.60	3.80
Rubber Perfume 12*	lb.	——	4.35
Russian Leather 7*	lb.	——	4.35
Vanillin	lb.	2.75	2.80

BLOWING AGENTS

Ammonium Bicarbonate	cwt.	——	9.00
Better Blend Soda* (c.l., bags)	cwt.	——	2.70
B-I-K	lb.	.20	.22
Blowing Agent No. 81105*	lb.	.32	.35
Celogen*	lb.	——	1.95
AZ*	lb.	1.92	1.94
80	lb.	——	1.60
Diazo Amino Benzene	lb.	——	.73
Kempore R-125	lb.	——	1.92
Neo Fat 42-12*	lb.	.10¼	.12¼
Opex 40	lb.	——	.72
Sodium Bicarbonate, U.S.P. (c.l., bags)	cwt.	——	2.55
Unicel ND*	lb.	——	.72
S*	lb.	——	.20
Urea	lb.	.06	.07

BONDING AGENTS

Base 6986*	lb.	.27	.32
Braze*	gal.	6.00	9.00
Braze Cover Cement*	gal.	2.50	4.00
Chemlock 201, 203	gal.	5.00	7.50
220	gal.	8.95	12.00
401	gal.	5.00	24.00
607	gal.	18.00	24.00
614	lb.	4.35	4.75
Durez 12987*	lb.	.47½	.49
EX-B501-4	gal.	6.20	4.90
EX-B150-1	gal.	8.15	11.00
EX-B579-1	gal.	19.40	26.40
Gen-Tac Latex*	lb.	.70	.75
Hylene M*	lb.	1.25	1.50
M-50*	lb.	.86	1.11

BONDING AGENTS (Cont'd)

Penacolite B1A*	lb.	——	.95
R-2710*	lb.	——	.95
Pliobond 20*	gal.	2.91	4.23
30*	gal.	3.65	4.97
Rex Compounds*	gal.	1.30	1.90
Thixons*	gal.	3.30	9.00
Ty-Ply Q (BN & S)*	gal.	6.75	8.00
Tygobond 30*	gal.	4.10	5.40
40*	gal.	5.80	6.89
41*	gal.	8.65	9.85
45*	gal.	5.75	6.48
Vinculux	gal.	——	4.95

COAGULANTS

Acetic Acid—56% (bbls.)	cwt.	9.00	11.00
Glacial 99½% (dms.)	lb.	.12	.13
Calcium Nitrate, Tech. Flake	lb.	.07½	.09½
Hydroxyacetic Acid—70% (dms.)	lb.	——	.09½
Zinc Nitrate, Tech. Flake	lb.	——	.20

COLORING AGENTS

Black

Aquablak B*	lb.	.09¾	.10¾
M*	lb.	.10½	.11
S*	lb.	.11¾	.12¼
Black Shield 4*	lb.	.10	.10½
No. 6	lb.	.11	.11½
No. 17	lb.	.12½	.13
No. 19	lb.	.12	.12½
Carbon Black—See *Reinforcing Agents*			
Lampblack No. 10*	lb.	.06	.09
Mapico Black Iron Oxide* (50 lb. bags)	lb.	.14¾	.15
Pure Black Iron Oxide	lb.	.14¾	.15

Blue

Akron Masterbatches*	lb.	2.23	2.78
Toners*	lb.	2.30	6.35
Blue Powders	lb.	2.20	3.75
Cooke M.B. Blue* 426	lb.	2.20	3.75
Disco Blues	lb.	2.20	3.45
Monastral Rubber Blue CPL*	lb.	1.95	1.95
PCD, Dispersed*	lb.	——	2.55
Peacoline Blue*	lb.	——	3.85
Ramapo Blue*	lb.	2.75	3.00
Rubber Blue GD* (Disp.)	lb.	——	4.75
Rubber Blue X-1999*	lb.	——	1.90
Rubber Dispersed Blues	lb.	2.52	2.78
Solfast Blue*	lb.	1.60	3.25
Stan-Tone MBS*	lb.	2.20	2.85
GPE*	lb.	——	1.50
PEC*	lb.	.93	1.08
Ultramarine	lb.	.14	.30
Vansul Blue M.B.*	lb.	1.00	2.70

Brown

Brown Iron Oxide	lb.	.14¾	.15
Mapico Brown* (50 lb. bags)	lb.	.15¾	.16
Stan-Tone GPE*	lb.	——	3.00
Vansul Brown M.B.* (Organic)	lb.	——	2.30

Green

Akron Masterbatches*	lb.	1.53	3.08
Toners*	lb.	1.50	4.35
Cooke M.B. Green*	lb.	1.60	2.80
413*	lb.	——	2.80
Disco Greens	lb.	1.55	2.80
Green Powders	lb.	1.35	3.95
Hi-Fiz Fluorescent	lb.	1.60	2.60
Monastral Rubber Green GSD* (Dispersed)	lb.	——	2.80
GSL*	lb.	2.20	2.20
Permansa Green CP-1236*	lb.	——	1.45
Pigment Green B*	lb.	1.45	1.50
GL-652D*	lb.	.90	.95
Ramapo Green*	lb.	——	3.50
Rubber Dispersed Greens	lb.	1.23	3.08
Rubber Green FD* (Disp.)	lb.	——	2.05
Rubber Green X-1292*	lb.	——	1.75
Serene Green*	lb.	——	3.50
Solfast Green*	lb.	1.60	3.35
Stan-Tone MBS*	lb.	1.55	3.35
GPE*	lb.	——	3.00
PC*	lb.	2.20	2.25
Vansul Green M.B.*	lb.	1.50	2.75

Maroon

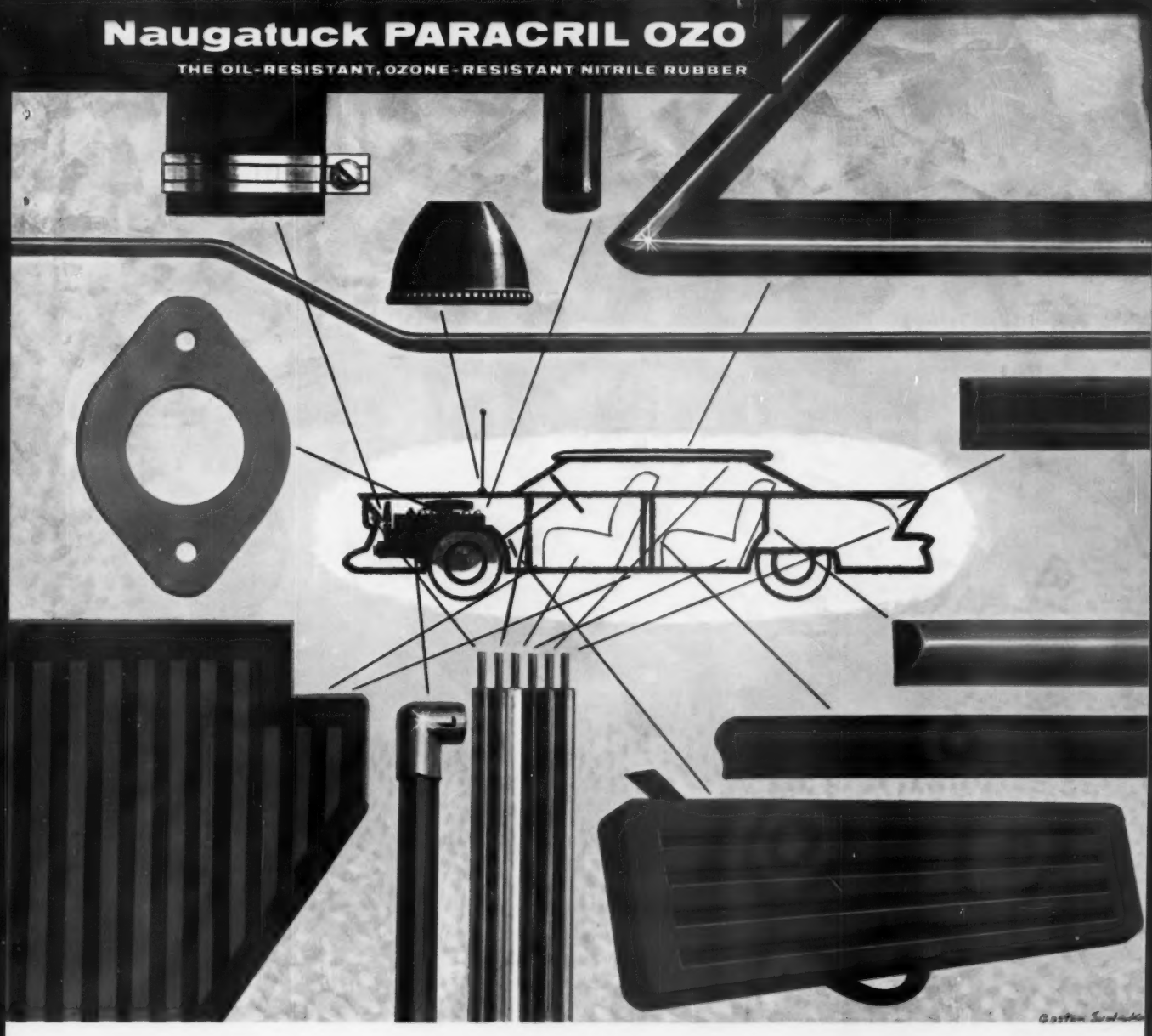
Akron Masterbatches*	lb.	3.53	4.38
Toners*	lb.	.98	5.60
Pyrolux Maroon*	lb.	——	3.40
Vansul Maroon M.B.*	lb.	——	4.05

Orange

Akron Masterbatches*	lb.	2.53	2.98
Toners*	lb.	2.97	4.30
Benzidene Orange	lb.	——	3.30
Cooke MB*	lb.	2.25	2.35
425*	lb.	——	2.25
Dianisidine Orange*	lb.	——	2.85
Disco Oranges	lb.	2.30	2.85
Hi-Fiz Fluorescent	lb.	1.40	2.40
Mercadium X-2667*	lb.	1.61	1.65
Molybdate Orange	lb.	——	.48
Oswego Orange X2065*	lb.	——	3.15
Rubber Orange OD* (Disp.)	lb.	——	2.25
Stan-Tone Cadmium Dry*	lb.	1.85	4.23
Cadmium Paste*	lb.	2.48	2.80
GPE*	lb.	1.20	4.35
PC*	lb.	.75	.80
Vansul Orange M.B.*	lb.	2.30	2.65

Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



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- significantly superior ozone resistance
- excellent fuel and oil resistance
- several times greater abrasion resistance
- permanent retention of bright colors for exterior styling and easily traceable wiring and other interior parts

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Watch Out For "EXPENSIVE BARGAINS" in ZnO!

Are You Tying Your Reputation For Product Quality to The Price Of Zinc?

Fluctuating zinc prices mean users of secondary ZnO can "enjoy" marginal savings over primary ZnO. But on this margin — about 5¢ per 100 pounds of finished compound — rests *your reputation as a manufacturer of a quality rubber product.*

WHY RISK YOUR REPUTATION FOR PENNIES?

Here, for example, is an "expensive bargain." Our laboratories analyzed two different lots of secondary ZnO from the same supplier and found:

1. **LEAD VARIATION .04 to .11**
2. **SULPHUR VARIATION .15 to .32**
3. **BOTH HAD PRESENT AN APPRECIABLE QUANTITY OF GRITTY PARTICLES**

These results are typical. For a minute saving, the secondary ZnO user risks UNPREDICTABLE CURING RATES, DISCOLORATION IN LIGHT-COLORED RUBBER PRODUCTS and STRUCTURAL FAILURE IN THIN-WALLED RUBBER PRODUCTS.

Hardly a bargain . . . instead 3 very good reasons for using

ST. JOE *Lead-Free* primary ZnO!

St. Joe uses the same ores to make ZnO as is used for the production of 99.99+% Special High-Grade slab zinc. This coupled with St. Joe's exclusive methods of quality control gives you primary ZnO with consistent analyses unmatched in the industry.

LEAD-FREE ST. JOE ZINC OXIDE

ZNO-151

As A Producer of Natural and Synthetic Rubber Products,

YOU CAN SET YOUR PROCESSING,
OUR OXIDE WILL NOT CHANGE

ST. JOSEPH LEAD CO.

250 Park Avenue, New York 17, N. Y.

Plant & Laboratory: Monaca (Josephtown), Pa.

A Leading Producer Of Quality Zinc Oxides For Over 30 Years.

COLORING AGENTS (Cont'd)

Red

Akron Masterbatches*	lb.	1.30	3.68
Toners*	lb.	.98	5.60
Arcturus Reds*	lb.	—	1.35
Antimony Trisulfide	lb.	.72	.78
R.M.P. Sulfur Free*	lb.	—	.78
R.M.P. No. 3*	lb.	—	.72
Brilliant Toning Reds*	lb.	1.77	1.90
Cadmolith Red* (dms.)	lb.	1.94	2.87
Cooke M.B. Red*	lb.	1.05	3.25
410*	lb.	—	1.75
Disco Reds	lb.	1.05	3.25
Graphic Red* (dlvd.)	lb.	.98	1.03
Hi-Fiz Fluorescent	lb.	1.15	2.15
Kroma Reds*	lb.	.14	.15
Lake Red C*	lb.	—	1.25
Mapico Reds* (50 lb. bags)	lb.	.14¼	.14½
Mercadium X-2668 Light*	lb.	1.62	1.68
X2669 Medium Light*	lb.	1.76	1.80
X-2670 Medium*	lb.	1.83	1.87
X-2671 Dark*	lb.	1.91	1.95
Oximony Red Iron Oxide	lb.	.14¼	.14½
Plasticone Red*	lb.	1.02	4.60
Polaris Red*	lb.	—	1.70
Recco Red Oxide*	lb.	.13½	.13¾
Red Iron Oxide, Light	lb.	.13¾	.14
Red Powders	lb.	—	4.40
Rubber Dispersed Reds	lb.	1.47	3.58
Rubber Red PBD* (Disp.)	lb.	—	2.05
2BD, Dispersed*	lb.	—	2.00
2BL*	lb.	1.24	1.24
PBL*	lb.	1.24	1.24
Rubanox Reds*	lb.	1.47	1.60
Rubber Red CP-339* (dlvd.)	lb.	—	1.10
Rubber Red X-1148*	lb.	—	.93
Solfast Red*	lb.	1.47	1.80
Stan-Tone MBS*	lb.	1.00	3.75
GPE*	lb.	.77	3.15
PC*	lb.	1.30	2.50
PDS*	lb.	1.40	1.55
PVC*	lb.	1.65	1.90
Vansul Red M.B.*	lb.	1.00	3.35
Watchung Red*	lb.	1.90	1.90

Tan

Mapico Tan 15* (50 lb. bags)	lb.	.23¼	.23½
20* (50 lb. bags)	lb.	.23¼	.23½

White—Lithopone

Permolith*	lb.	.0825	.09125
Sunolith*	lb.	.0800	.0875

White—Titanium Pigments

Iceberg*	lb.	—	.0265
Icecap K*	lb.	—	.03¼
Horse Head Anatase Grades*	lb.	.25½	.26½
Rutile Grades*	lb.	.27½	.28½
Stan-Tone PC*	lb.	.55	.60
Ti-Cal*	lb.	.09	.09¼
R-22*, R-25*, R-27*, R-30*	lb.	.09¾	.09⅞
R-60*	lb.	.09⅞	.10¼
Ti-Pure*	lb.	24½	27½
Anatase Grades*	lb.	25½	26½
R-100*, R-500*	lb.	.27½	28½
Titanox A*—all grades (dlvd.)	lb.	.25½	.26½
C-50* (dlvd.)	lb.	.14½	.14⅞
RA* (dlvd.)	lb.	.27½	.28½
RA-10* (dlvd.)	lb.	.27½	.28½
RA-NC* (dlvd.)	lb.	.27½	.28½
RC* (dlvd.)	lb.	.09¾	.10⅛
RC-HT* (dlvd.)	lb.	.09¾	.09⅞
Unitane O-110*	lb.	.25½	.26½
O-220*	lb.	.25½	.26½
O-310*	lb.	.25½	.26½
O-410*	lb.	.25½	.26½
OR-150*	lb.	.27½	.28½
OR-250*	lb.	.27½	.28½
OR-340*	lb.	.27½	.28½
OR-342*	lb.	.27½	.28½
OR-350*	lb.	.27½	.28½
OR-540*	lb.	.27½	.28½
OR-640*	lb.	.27½	.28½
Zopaque*	lb.	.24½	.25½
R*	lb.	.26½	.27½

White—Zinc Oxide (American Process)

AZODOX 44, 45	lb.	.1450	.1550
AZO-ZZZ 11*, 22*, 33*, 44* 55*	lb.	.1450	.1550
Eagle-Picher AAA*	lb.	.1450	.1550
Horse Head Special*	lb.	.1450	.1550
XX*	lb.	.1450	.1550
Protox 166*	lb.	.1450	.1550
167*	lb.	.1450	.1550
267* (pelleted)	lb.	.1450	.1550
St. Joe Black Label*	lb.	.1450	.1550
Green Label*	lb.	.1450	.1550
Red Label*	lb.	.1450	.1550
Pelleted	lb.	.1450	.1550
Sherwin-Williams Oxide*	lb.	.1350	.1450

COLORING AGENTS (Cont'd)

White—Zinc Oxide (Dispersed)

Dispersed Zinc Oxide	lb.	—	.13

White—Zinc Oxide (French Process)

AZO-ZZZ 66	lb.	.1450	.1550
Florence Green Seal*	lb.	.1625	.1725
Red Seal*	lb.	.1575	.1675
White Seal*	lb.	.1675	.1775
Kadox 25*	lb.	.1675	.1775
15*, 17*, 72* & 515*	lb.	.1450	.1550
Protox 168*	lb.	.1450	.1550
169*	lb.	.1450	.1550
268* (pelleted)	lb.	.1450	.1550
U.S.P. (cartons)	lb.	.1775	.1875
XX-78*	lb.	.1450	.1550

White—Zinc Sulfide

Cryptone ZS*	lb.	.2530	.2630
Lehigh 35%*	lb.	.15125	.16125
50%	lb.	.15375	.16375

Yellow

Akron Masterbatch*	lb.	1.27	2.48
Toners*	lb.	2.20	6.00
Benzidene-Lightfast	lb.	3.40	5.35
Benzidine Yellow	lb.	1.41	2.55
Cadmolith Yellow (dms.)	lb.	1.12	1.20
Chrome Yellow	lb.	.35	.35
Cooke M.B. Yellow 405*	lb.	2.15	2.75
Disco Yellows	lb.	2.05	3.95
Hi-Fiz Fluorescent	lb.	1.60	2.60
Iron Oxide, Pure Light Shades	lb.	.12½	.12¾
Dark Shades	lb.	.12	.12¼
Mapico Yellow* (50 lb. bags)	lb.	.12	.12¼
Rubber Dispersed Yellows	lb.	1.27	2.13
Rubber Yellow GD* (disp.)	lb.	—	2.25
GL*	lb.	—	1.68
Rubber Yellow X-1940*	lb.	—	2.35
Stan-Tone Cadmium Dry*	lb.	2.80	2.98
Cadmium Paste	lb.	1.77	1.79
MBS*	lb.	1.30	2.20
GPE*	lb.	.77	3.25
PC*	lb.	.55	3.40
Toluidine Yellow	lb.	2.20	2.20
YL-660 D*	lb.	1.25	1.35
Oximony Iron Oxide	lb.	.14¼	.14½
Vansul Yellow M.B.*	lb.	1.15	2.15
Yellow Powders	lb.	2.00	5.00
Zinc Yellow	lb.	.29	.29

DISPERSING AGENTS

Anchoid*(†)	lb.	.24	.25
Anhydrapent*	lb.	.56	.59
Armeen 18*	lb.	.39	.45
Belloid TD*	lb.	.15¾	.16¾
Blancol*	lb.	—	.15¾
Darvan No. 1*, No. 2*, No. 3*	lb.	.22	.35
No. 6*	lb.	.15¼	.15¾
No. 7*	lb.	.18¾	.23¾
Daxad 11* (21*, 23*)	lb.	.08	.30
Diethanolamine (dms., dlvd.)	lb.	.24½	.27
Dispersaid*	lb.	1.25	1.35
Emcol K-8300* (dms.)	lb.	.14	.18
P10-59	lb.	.32	—
5120	lb.	.31	—
5138	lb.	.31	—
Emulphor ON-870*	lb.	—	.55
Furala*	lb.	.06½	.07½
Halloid*	lb.	.04½	.05½
Igepal CO-630*	lb.	—	.29
Igepon T-73*	lb.	—	.29½
Kyro EO* (dms.)	lb.	—	.29¾
Leonil SA*	lb.	—	.55
Lipal No. 9-N*	lb.	.28	.29
11-O*	lb.	.28	.29
Lomar PW*	lb.	.15¼	.15¾
Marasperse C*	lb.	.06¼	.06¾
CB*	lb.	.15	.17
N*	lb.	.09½	.10½
Monoethanolamine (dms., dlvd.)	lb.	.25	.27½
Naccotan A*	lb.	.16½	.17
Nekal BA-75*	lb.	—	.40
BX-78*	lb.	—	.64
Nopco 1187-X*	lb.	.15	.16
Pluronic F68*	lb.	.38½	.44
Polyfon*	lb.	.08	.10
R & R 551*	lb.	—	.28
Stablex B*	lb.	.50	.95
Stan-Chem BQC*	lb.	.12¼	.17½
1067*	lb.	—	.13½
1471*	lb.	.1687	.2187
2251*	lb.	.12½	.17⅜
Trenamine D-25*	lb.	.32½	.36
Triethanolamine (dms., dlvd.)	lb.	.22	.25½
Yelkin TT* (and TTS*)	lb.	.13	.16

EXTENDERS

Arcco 1294-36B*	lb.	.11½	.12½
Car-Bel-Ex-A* (and B*)	lb.	—	.14
Extender 600*	lb.	—	.1870
Facile Gum 4A*	lb.	.48	.50
Millex*	lb.	—	.07
W*	lb.	—	.07
Nopco 2271*	lb.	.16¾	.18¾
OPD*	lb.	.29	.40
Polyco 418*	lb.	.17	.18
PR-162 Latex Extender*	lb.	—	.182

EXTENDERS (Cont'd)

Solvitose HDF*	lb.	.22	.25
Synprolac*	lb.	.16	.23
Synprowax*	lb.	—	.23
Vanadiset B*	lb.	.0360	.07
C*	lb.	.0310	.06
MR* 80 mesh	lb.	.08½	.12½
Vistanex MM Grades*	lb.	—	.35
Wilcarbo Carbon Powders*	lb.	.08	.15

FILLERS (Inert and Reinforcing)

Abrasives			
Carbonite*	lb.	.21½	1.35
Lionite*	lb.	.16	1.27
Pumice	lb.	.03	.05
Walnut Shell Grits	ton	60.00	110.00
Aluminum Hydrate	lb.	.031	.170
Kaiser Aluminum Hydrate*	lb.	.035	.065
Aluminum Silicate			
AFD*	ton	29.50	36.00
Aluminum Flake*	ton	29.50	36.00
Marter White*	ton	18.50	30.00
Barium Carbonate (l.c.l.)	ton	109.00	126.50
Barytes			
No. 1 Floated, White*	ton	55.00	79.85
No. 2 Floated, Unbleached*	ton	50.00	74.85
No. 22 Barytes* (c.l.)	ton	—	30.00
No. 3805 Barytes*	ton	22.00	26.75
Foam A*	ton	—	55.00
Sparmite*	ton	80.00	90.00
XIOR*	ton	90.00	95.00
Bentonite (c.l.)	ton	—	13.50
Argosite Clay* (c.l.)	ton	—	12.50
Bennett Clay* (c.l.)	ton	—	32.50
SPV Volclay* (c.l.)	ton	—	13.50
White Hi-Gel*	ton	—	65.90
Blanc Fixe	ton	125.00	142.00
Calcium Carbonate			
Allied Whiting	ton	—	11.50
Atomite* (c.l.)	ton	32.50	35.00
B.I. White No. 1 (c.l.	ton	—	10.00
Calcene NC*	ton	80.00	100.00
TM*	ton	82.50	102.50
Calwhite*	ton	20.00	25.00
Camel-Carb*	ton	—	14.00
Camel-Tex*	ton	—	22.00
Camel-Wite*	ton	—	35.00
Carbium	ton	30.00	40.00
CCO White*	ton	—	22.00
Duramite*	ton	20.00	22.00
Gamaco* (c.l.)	ton	32.50	37.50
Georgia Marble 5-25* (c.l.)	ton	—	20.00
No. 10 White* (c.l.)	ton	—	11.00
Kalite*	ton	52.50	67.50
Laminar*	ton	—	30.00
Leamite* (c.l.)	ton	—	27.50
Lorite*	ton	30.00	36.00
Millical*	ton	38.00	53.00
Multifex MM*	ton	117.50	137.50
Non-Fer-Al*	ton	35.00	50.00
Purecal M*	ton	56.75	80.75
SC* (and T*)	ton	110.00	125.00
U*	ton	120.00	135.00
PPTD* (c.l.)	ton	—	30.00
Rambo No. 1*	ton	—	11.50
Snowflake*	ton	20.00	22.00
Super Multifex*	ton	167.50	187.50
Surfex*	ton	42.00	57.00
Suspenso*	ton	38.00	43.00
Witcarb Reg.*	ton	60.00	85.00
R*	ton	127.50	150.00
RC*	ton	117.50	140.00
York White*	ton	—	11.50
Calcium Silicate			
Silene EF*	lb.	.06	.07
Calcium Sulfate, Anhydrous			
Snow White Filler*	ton	—	22.00
Calcium Sulfate Hydrous			
Terra Alba No. 1*	ton	—	17.00
Chalk Whiting (l.c.l.)	lb.	.01½	.01¾
Recco Paris Whiting*	ton	—	35.00
OMYA Whiting*	ton	—	35.00
Clay			
Afton Clay*	ton	13.00	38.00
Aiken Clay*	ton	14.50	—
Akron HC-100*	ton	14.50	—
HC-75*	ton	13.00	—
SC-25*	ton	14.50	—
Alsilite* (c.l.)	ton	30.00	45.00
Aluminum Flake*	ton	25.50	28.50
Borden R*	ton	13.00	18.00
Buca* (c.l.)	ton	—	45.00
Burgess No. 20*	ton	—	33.00
No. 30*	ton	—	40.00
Burgess Iceberg*	ton	—	53.00
Icecap K*	ton	—	65.00
Catalpo* (c.l.)	ton	33.00	—
Champion*	ton	—	14.50
Crown*	ton	—	14.50
Dixie* (c.l.)	ton	—	14.50
Dover*	ton	—	13.00
Franklin Clay—R* (c.l.)	ton	16.00	41.50
G. K. Soft*	ton	11.00	28.00
Glomax HE (bags)	lb.	65.00	—
LL (bags)	lb.	53.00	—
PVR (bags)	lb.	40.00	—
WZ (bags)	lb.	45.00	—
Harwick Clays*	ton	21.50	77.00
Hydrite RS (bags)	lb.	30.00	—
PXS (bags)	lb.	45.00	—
UF (bags)	lb.	100.00	—
10S (bags)	lb.	50.00	—
Flat "D" (bags)	lb.	25.00	—

FILLERS (Cont'd)

Hi-White R*	ton	14.50	—
Kaolinod Clay* (c.l.)	ton	—	10.50
LGB*	ton	17.50	22.50
LGP*	ton	20.00	25.00
McNamee* (c.l.)	ton	—	14.50
Natka 1200	ton	13.00	35.00
Par* (c.l.)	ton	—	12.00
Paragon*	ton	14.50	19.50
Pigment 5*	ton	27.50	34.50
33*	ton	—	40.00
Polyfil 40	ton	40.00	—
70	ton	53.00	—
80	ton	65.00	—
C	ton	65.00	30.00
F	ton	45.00	50.00
X	ton	33.00	38.00
Recco* (c.l.)	ton	—	14.50
Swanee Clay*	ton	—	12.50
Snobrite*	ton	—	12.50
Suprex*	ton	14.50	19.50
Whitetex* (c.l.)	ton	53.00	—
Windsor*	ton	14.50	39.50
4200 Clay*	ton	13.00	—
Diatomaceous Earth	ton	30.00	50.00
Celatom MN-33	ton	36.00	95.00
MP-25	ton	55.00	121.00
MP-63	ton	55.00	121.00
Celite 270	ton	55.00	121.00
292	ton	36.00	95.00
315; 350	ton	137.00	225.00
Kaylorite* (c.l.)	ton	—	30.00
Lorite*	ton	—	36.00
Flock			
Cotton (White)	lb.	.28	.30
Colored	lb.	.12	.20
Filfloc F 40-9000*	lb.	—	.13
F 6000*	lb.	—	.36
Nylon	lb.	—	.35
Polycel*	ton	110.00	210.00
Rayon, Bleached or Dyed	lb.	.75	1.20
Rayon, Grey	lb.	—	.18
Rayon, Pink	lb.	—	.20
Solka-Floc* (l.c.l.)	lb.	.07	.16
Glue, Amber	lb.	.17	.19
Ground Softwood Bark			
Silvacon* (c.l.)	ton	55.00	100.00
Leather			
Flour (dust)	lb.	.12	.15
Shredded	lb.	.05	.17
Lignin	lb.	.06	.08
Indulin*	lb.	.06	.08
Limestone, Pulverized	ton	3.00	5.00
Asbestol Regular*	ton	28.00	—
Asbestol Superfine*	ton	33.00	—
Georgia Marble No. 10*	ton	—	11.00
Industrial Filler No. 100*	ton	—	7.75
Micro Velva A*	ton	53.00	—
L*	ton	61.00	—
No. 1 White*	ton	—	11.00
Magnesium Carbonate	lb.	.10½	.13
K & M Technical* (c.l., eqld.)	lb.	.10½	.12
Marinco CL*	lb.	.11	.13
Michigan*	lb.	.11	.13
Magnesium Silicate (see Talc)			
Mica	lb.	.01¼	.07¼
Concord*	lb.	.08	.08¾
Micro-Mica*	lb.	.08	.08¾
Mineralite* (c.l.)	ton	40.00	85.00
Silversheen*	lb.	.08	.08¾
Triple A Mica* (c.l.)	ton	—	40.00
Vermiculite*	lb.	—	.11
Wet Ground Biotite Mica	lb.	.06½	.07¼
Wet Ground Mica No. 160*	lb.	.08	.08¾
Pecan Shell Flour			
Stan Shell*	ton	45.00	75.00
Pyrophyllite			
No. 261*	ton	—	11.50
Pyrax A* (c.l.)	ton	14.50	15.00
WA* (c.l.)	ton	17.00	17.50
Sawdust, Graded	ton	14.00	35.00
Silica	ton	16.00	27.00
Extra Fine (baga) (c.l.)	ton	—	43.00
Slate, Powdered (l.c.l.)	ton	15.00	20.00
Lo-Micron Slate Flour*	lb.	—	.04½
No. 133 Slate Flour*	ton	—	4.55
Sodium Silico Aluminate			
Zeolex 23*	lb.	.06	.07
Talc (Magnesium Silicate)			
Akron Soapstone*	ton	—	9.75
Asbestol Regular*	ton	—	27.00
Eastern RC-500*	ton	—	32.00
No. 41*	ton	—	19.70
No. 549*	ton	—	63.00
French*	ton	—	59.00
No. 367*	ton	—	13.00
No. 1600*	ton	—	70.60
No. 1768*	ton	—	13.00
Nytal 200* (c.l.)	ton	—	28.00
300* (c.l.)	ton	—	38.00
Sierra Fibrene C-400*	ton	34.00	40.00
Sierra Supreme 325*	ton	51.00	56.00
Sierra White*	ton	21.75	26.75
Soapstone*	ton	—	13.00
Walnut Shell Flour	ton	55.00	100.00
Agrashell*	ton	55.00	115.00
Stan-Shell*	ton	50.00	100.00
Whiting, Commercial	ton	—	7.50
Allied Whiting*	ton	—	11.50
Camel-Carb*	ton	—	10.00

FILLERS (Cont'd)

Calwhite (c.l.)	ton	—	20.00
C-C-O White*	ton	—	22.00
Georgia Marble No. 15*	ton	—	20.00
No. 10*	ton	—	20.00
Piqua No. 1 YAA* (c.l.)	ton	10.00	10.00
No. 2 LS* (c.l.)	ton	10.00	10.00
Snowflake* (c.l.)	ton	20.00	22.00
Stan-White 325*	ton	11.50	14.10
Ultrasil*	lb.	.35	.50
Veroc* (c.l.)	ton	—	11.50
Welco* (c.l.)	ton	—	10.50
York White R* (c.l.)	ton	—	11.00
Wood Flour	ton	31.50	48.00

FINISHING MATERIALS, SURFACE

Beaco Finishes*	gal.	2.10	2.35
Black Out*	gal.	4.50	8.00
Calcium Hypochlorite (dms.) (cwt.)	ton	33.30	37.90
Shellac, Orange Gum	lb.	.35	.45
VanWax*	gal.	2.00	2.05

FLAME RETARDANTS

Celluflex CEF* (dms.)	lb.	—	.65
Chlorowax 40*	lb.	.15	.17½
50*	lb.	.16	.18½
70*	lb.	.18½	.20
Halowax*	lb.	.36	.46
Zinc Borate 3167*	lb.	.1920	.2020
Zyrox Compounds*	lb.	.38	.95½

LATEX MODIFIERS

Crux*	lb.	.30	.65
Foamnix*	lb.	.60	1.50
Ludox	lb.	.15	.16¾
OPD-101*	lb.	.29	.40
Piccopale A-1 Emulsion	lb.	.086	.113
A-20	lb.	.089	.116
A-22	lb.	.097	.124
A-41; A-43	lb.	.0775	.0145
C-1	lb.	.091	.118
N-3	lb.	.100	.127
STAYB*	lb.	.25	.45
Ubatol U-2001* (t.c.)	lb.	.166	.187
U-2003* (t.c.)	lb.	.184	.208
U-2007* (t.c.)	lb.	.166	.187
U-3025* (c.l.)	lb.	.223	.235
U-3040* (c.l.)	lb.	.260	.272
U-3045* (c.l.)	lb.	.260	.272
U-3050* (c.l.)	lb.	.195	.207
Webnix*	lb.	1.25	2.00

LUBRICANTS, MOLD

Akro Gel*	lb.	—	.165
Alipal CO-433*	lb.	—	.20
CO-436*	lb.	—	.24
Aluminum Stearate Crown Brand*	lb.	.37	.42
Amine, Mixed Crude*	lb.	.19	.25
Aquadag*	lb.	3.50	4.00
Aquarex D*	lb.	—	.81
L*	lb.	—	.94
ME*	lb.	—	.82
MDL*	lb.	—	.33
WAQ*	lb.	—	.22
Armeen HT*	lb.	.34	.40
180*	lb.	.52	.56
Armid HT (flaked)*	lb.	.42	.46
0*	lb.	.39	.41
Borax, Granular (l.c.l.)	ton	89.00	94.00
Carbowax 4000*	lb.	.31	.32
CD Mold Release B*	gal.	5.00	—
B-2*	gal.	5.00	—
Colite Concentrate* (dms.)	gal.	.90	1.15
Colite D43D*	gal.	1.15	1.40
Concentrex*	lb.	—	.25
Dag Dispersion No. 197*	lb.	1.95	2.90
D.C. 7 Compound*	lb.	5.05	6.50
D.C. Emulsion No. 7*	lb.	1.59	2.07
No. 8*	lb.	1.20	1.74
No. 35*; 35A*	lb.	1.20	1.74
No. 35B*	lb.	1.20	1.74
No. 36*	lb.	1.20	1.74
D.C. Mold Release Fluid*	lb.	3.04	3.61
Dri-Lube*	lb.	—	.22
Dryflo* (bags)	lb.	21.40	21.55
Emulsion Lubricant A80*	lb.	—	1.20
45*	lb.	—	1.20
G-E Silicone Emulsion			
SM-55*	lb.	1.15	1.69
SM-61*	lb.	1.15	1.69
SM-62*	lb.	1.15	1.69
G-E Silicone Fluid SF-92*	lb.	2.90	4.05
SF-96*	lb.	2.90	4.05
Hawkeye Flake* (dlvd.)	lb.	.15	.15¾
HSC No. 35*	lb.	1.22	2.46
No. 515	lb.	1.22	2.46
Igepal CO-430*	lb.	—	.29
CO-630*	lb.	—	.29
CO-530*	lb.	—	.29
Igepon AP-78*	lb.	—	.48
T-33*	lb.	—	.21
T-51*	lb.	—	.13½
Kokobace R*	lb.	.17½	.18¾
Lipal 9-N*	lb.	.28	.29
7-O*	lb.	.29	.30
Lubrex	lb.	.25	.30
Lubri-Flo*	gal.	10.00	12.00
Migralube*	lb.	—	.35
ML-1027-2C*	gal.	—	2.65
ML-1028-2C*	gal.	—	2.65

LUBRICANTS, MOLD (Cont'd)

Mold Lubricant No. 72 Conc.* (dms.)	gal.	—	1.90
Mold Lubricant No. 735* (dms.)	gal.	—	1.25
No. 769* (dms.)	gal.	—	1.20
No. 825* (dms.)	gal.	—	2.00
No. 856* (dms.)	gal.	—	1.90
No. 880* (dms.)	gal.	—	1.19
No. 887* (dms.)	gal.	—	1.80
No. 935* (dms.)	gal.	—	1.56
No. 956* (dms.)	gal.	—	2.50
No. 965* (dms.)	gal.	—	2.15
No. 967* (dms.)	gal.	—	2.40
No. 969* (dms.)	gal.	—	1.50
No. 970* (dms.)	gal.	—	4.50
No. 975* (dms.)	gal.	—	2.85
No. 980* (dms.)	gal.	—	1.53
No. 987* (dms.)	gal.	—	2.45
A 187* (dms.)	gal.	—	1.90
A 256* (dms.)	gal.	—	1.20
A 988* (dms.)	gal.	—	2.60
Moldeze No. 3*	gal.	—	4.95
Mold-Brite*	gal.	—	1.50
Monopole Oil MD*	lb.	—	.16
MR-22 Silicone Semi-Permanent	gal.	9.95	14.95
Olate Flakes*	lb.	.23½	.24¾
Orvus WA Paste* (dms.)	lb.	—	.23¾
Plaskon Polyethylene S*	lb.	.32	.47
Poly-Brite PE-20	lb.	.28	.42
600	lb.	.42	.58
Poly-Cone 125X	lb.	1.15	1.30
1,000	lb.	.91	1.04
Polyglycol 15-200*	lb.	.25	.28¾
E4000*	lb.	.31	.37
Prodag*	lb.	.32	.60
Purity Flake* (dlvd.)	lb.	.18¾	.19¾
Rubber-Flo*	gal.	1.25	2.00
Rubber-Glo*	gal.	—	.94
Rusco Mold Paste*	lb.	—	.25
Sericite* (l.c.l.)	ton	65.00	75.00
Silicone Oil A145*	lb.	3.22	3.61
A220* (dms.)	lb.	—	2.80
Silrex (dms.)	lb.	—	.65
A65*	lb.	2.50	2.75
Rubars*	lb.	—	.22¾
Soybean Lecithin	lb.	.13	.17
Thermalube*	lb.	—	.13¾
UC Silicone L-45*	lb.	2.90	4.61
L-522*	lb.	2.68	3.50
LE-45*	lb.	1.15	1.69
LE-450*	lb.	1.15	1.69
Ucon Lubricants*	lb.	.26¾	.27¾
Ulco Mold Soap*	lb.	.19	.29

LUBRICANTS, RUBBER

Cyclolube NN-1; NN-2; NN-3	gal.	.12½	.20½
NN-4	gal.	.13½	.21½
114	gal.	.19	.27
4053	gal.	.21	.29
Digiycol Stearate Neutral (and SE) (dms.)	lb.	—	.25
Extrud-o-Lube*	gal.	1.33	1.54
Ivory Chips*	lb.	.19¾	.20¾
LatexLube GR* (dlvd.)	lb.	.19¼	.21½
No. 82-A* (450 lb. dms.)	lb.	—	.08½
Propylene Stearate (dms.)	lb.	.35	.60

LUBRICANTS, RUBBER SURFACE

Antidust	lb.	.37	.41
Barium Stearate	lb.	.41	.46
Calcium Stearate	lb.	.39	.44
Crown Brand*	lb.	.37	.42
D.C. 7 Compound*	lb.	5.05	6.50
D.C. 200 Fluid*	lb.	3.04	3.61
ELA*	lb.	—	.82
G-E Silicone Fluid SF-92*	lb.	3.04	4.25
Glycerized Lubricant*	gal.	1.25	1.48
Glydag B*	lb.	1.60	2.25
Glyso-Lube* (dms.)	lb.	—	.14
No. 3* (dms.)	lb.	—	.14
HSC No. 35*	lb.	1.28	1.34
No. 515*	lb.	1.28	1.34
Hydro-Zinc*	lb.	—	.20
Latex-Lube Pigmented* (dlvd.)	lb.	.17¼	.19¼
R-66*	lb.	—	.17¼
Liqui-Lube* (dlvd.)	lb.	—	.17¾
N.F.* (dlvd.)	lb.	—	.17¾
N.T.* (dlvd.)	lb.	—	.16¾
Lubrex*	lb.	.25	.30
Lubri-Cote	gal.	.86	1.00
Magnesium Stearate	lb.	.42	.47
Crown Brand*	lb.	.40	.45
Polyethylene Glycol	lb.	.22	.26
Rubber Free (Concentrate)*	gal.	—	1.44
Jel*	lb.	.18	.21½
Separex*	lb.	—	.10½
Slab-Dip* (dms.)	lb.	—	.17
Soybean Lecithin	lb.	.13	.17
Stock-Lube*	lb.	—	.19
UC L-45*	lb.	2.90	4.61
L-522*	lb.	2.68	3.50
LE-450*	lb.	1.15	1.69
XL-42*	lb.	3.10	4.75
XLE-42*	lb.	1.22	1.70
XLE-420*	lb.	1.18	1.70
Zinc Stearate	lb.	.41	.46

SMACO

Models 200 & 400

Gasket Splicer

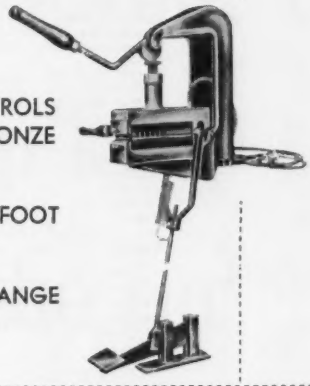
Features:

★ SPEED

★ HEAT CONTROLS IN BOTH BRONZE PLATENS

★ HAND OR FOOT OPERATED

★ QUICK CHANGE OF MOLDS



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Eliminates Special Molding and Trimming

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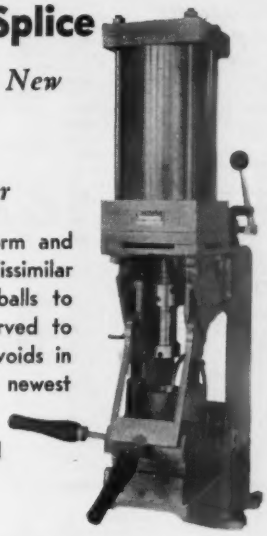

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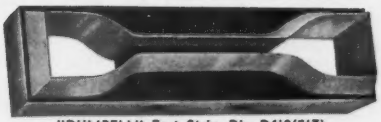
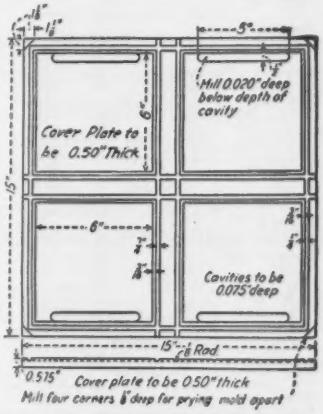
For Rubber Testing and Production



"DUMBELL" Test Strip Die D412(SIT)

For making tensile test samples, we make many types of slab molds. One is detailed at the right. These are plain or chrome finished. We usually stock molds for making adhesion, abrasion, flexing, compression and rebound test samples, but supply special molds promptly. We also furnish hand-forged tensile dies for cutting regular or tear test samples.

SLAB MOLD D15-55


Mill 0.020" deep below depth of cavity
Cover Plate to be 0.50" Thick
Cavities to be 0.075" deep
15" - ½ Rod
0.515"
Cover plate to be 0.50" thick
Mill four corners ⅛" deep for prying mold apart

HOGGSON & PETTIS MFG. CO., 141A Brewery St., New Haven 7, Conn.

Pac. Coast: H. M. Royal, Inc., Downey, Calif.

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GALEX – a non-oxidizing ROSIN

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MOLD CLEANERS

Actusol* (dlvd.)	gal.	1.45	1.65
Alkon* (dlvd.)	lb.	.16	.16½
CA-301*	gal.	—	2.49
CA-302*	gal.	—	2.63
G-O 6910*	lb.	.38	.40
Metso Anhydrous*	cwt.	5.70	7.95
Metso 99*	cwt.	5.00	7.25
200*	cwt.	6.70	8.95
Granular*	cwt.	4.45	6.70
Orvus Extra Granules*	lb.	.23½	.24¼
Polo*	lb.	.12¾	—
Rubber-Sol*	gal.	2.97	3.97
Shelblast*	lb.	.04	.08¾
Sprex A.C.* (dlvd.)	lb.	.17¾	.18¾
Zip Mold Cleaner*	gal.	1.05	1.55

PEPTIZING AGENTS

Peptizer P-12*	lb.	.95	1.25
Pepton 22 Plasticizer*	lb.	.83	.86
65*	lb.	1.23	1.26
65B*	lb.	.83	.86
Pitt-Consol 640 (dms.)	lb.	—	.42
RPA 2*	lb.	—	.85
3*	lb.	—	.51
3 Conc.*	lb.	—	.85
6*	lb.	—	1.66

PLASTICIZERS & SOFTENERS

Acto 500*	lb.	—	.09
Adipol BCA*	lb.	.47	.47½
2EH*	lb.	.42½	.43½
10A*	lb.	.42½	.43½
ODY*	lb.	.45½	.46½
810*	lb.	.42½	.45¼
XX*	lb.	.42½	.43½
Admex 562 (dms.)	lb.	.50¾	.51¼
710 (dms.)	lb.	.35¾	.36¼
711 (dms.)	lb.	.37¾	.38¼
744 & 745 (dms.)	lb.	.41¾	.42¼
760 (dms.)	lb.	.59¾	.60¼
761 (dms.)	lb.	.46¾	.47¼
770 (dms.)	lb.	.42¼	.43
Anhydrol 6990*	lb.	.51	.56
Arneel SD*	lb.	.34	.40
Arolene 1980* (c.l.)	lb.	—	.10
Aromatic Plasticizer 10* (and 25*) (dms.)	lb.	.06	.07½
Aromatic Tar	gal.	.0573	.1973
Bardol*	lb.	.02¾	.03¾
B*	lb.	.06¼	.06½
Bayol D*	gal.	—	.382
F*	gal.	—	.52
Bearflex 1751*	lb.	.14	.15
LPO*	lb.	.03	.04
MPO*	lb.	.03¾	.04¾
Beeswax, Bleached	lb.	.73	.75
Yellow Refined	lb.	.64	.65
Bondogen*	lb.	.55½	.60½
B.R.C. No. 20*	lb.	.0150	.0175
No. 21*	lb.	.02¼	.03
No. 22*	lb.	.02½	.02¾
B.R.H. 2*	lb.	.0213	.0351
BRS 700*	lb.	.0200	.0285
B.R.T. 3*	lb.	.0180	.0265
4*	lb.	.0250	.0260
7*	lb.	.0300	.0310
B.R.V.*	lb.	.0475	.0565
Bunarex Resins*	lb.	.07	.08
Bunatak AH*	lb.	—	.09½
N*	lb.	—	.31
U*	lb.	—	.17½
No. 90*	lb.	—	.09
No. 210*	lb.	—	.14
Butac*	lb.	.1585	.1685
Butyl Carbitol Perlargonate (dms.)	lb.	—	.64½
Butyl Cellosolve Perlargonate (dms.)	lb.	—	.68
Butyl Oleate	lb.	.26	.27
Butyl Palmitate	lb.	—	.26½
Butyl Stearate (dms.)	lb.	.26	.27¾
Byerflux*	gal.	.24	.27
Califlux 510* (and 550*)	lb.	.02¾	.03¾
G.P.*	lb.	.01½	.02½
R-100*	lb.	.04¾	.05¾
LBL*	gal.	.17	.25
OSR*	lb.	.01⅞	—
RC*	gal.	.13½	.21½
TT*	lb.	.0195	.0295
Candelilla Wax, Prime	lb.	.53	.64
Refined Light	lb.	.56	.60
Carbowax 4000* (dms.)	lb.	.68	.70
Cardolite NC-103*	lb.	.36	.59
Carnauba Wax, Crude	lb.	.73	.74
Flaked	lb.	.73	1.25
Refined, Technical	lb.	.73	.74
Refined, Pure	lb.	.82	.86
Yellow	lb.	1.10	1.15
Celluflex* (dms.)			
112* (t.c., dlvd.)	lb.	—	.32½
179-A* (t.c., dlvd.)	lb.	—	.32½
179-C* (t.c., dlvd.)	lb.	—	.32½
179-EG* (t.c., dlvd.)	lb.	—	.32½
DBP* (t.c., dlvd.)	lb.	—	.30
DOP* (t.c., dlvd.)	lb.	—	.28½
TPP* (dms., eqld.)	lb.	—	.40
Ceresin Wax	lb.	.12	.30
Chlorowax 40*	lb.	.15	.17½
50*	lb.	.16	.18½
70*	lb.	.18½	.20
LV*	lb.	.17	.19½

PLASTICIZERS & SOFTENERS (Cont'd)

CTLA Polymer*	gal.	.20	.36
Cumar Resins*	lb.	.07	.19
Cyclolube OSR*	gal.	.28	.36
Darex DBM*	lb.	.30½	.34
DBP*	lb.	.30	.33½
DOP*	lb.	.30½	.33½
DIOP*	lb.	.30½	.33½
D.B.M.*	lb.	.32	.34¾
Decylbutyl Phthalate	lb.	.27	.29½
Degras, Common	lb.	—	.14
Diallyl Phthalate	lb.	.51½	.52½
Dibenzyl Sebacate (dms.)	lb.	.93	.93½
Dibutoxyethyl Sebacate	lb.	—	.61½
Dibutyl Phthalate (dms.)	lb.	.28½	.30
Dibutyl Sebacate	lb.	.67½	.68
Dicapryl Adipate (dms.)	lb.	.41½	.42½
Dicapryl Phthalate (dms.)	lb.	.27½	.29
Dicapryl Sebacate	lb.	.58	.59½
Di-Carbitol Phthalate (dms.)	lb.	.49	.49½
Dicyclohexyl Phthalate	lb.	.45	.46½
Diethyl Phthalate (dms.)	lb.	.27½	.29
Di-2-ethylhexyl Phthalate (dms.)	lb.	.27½	.29
Dihexyl Adipate (dms.)	lb.	.46½	.47½
Dihexyl Phthalate (dms.)	lb.	.32½	.33½
Dihexyl Sebacate (dms.)	lb.	.66	.66½
Diisobutyl Azelate	lb.	—	.47¾
Diisobutyl Phthalate	lb.	.28	.29½
Di-iso-octyl Adipate	lb.	.42½	.43½
Dimethyl Phthalate (dms.)	lb.	.27½	.29
Dimethyl Phthalate	lb.	.27½	.29
Dimethyl Sebacate (dms.)	lb.	1.30	1.30½
Dinonyl Adipate	lb.	.44½	.47½
Dinopol IDO*	lb.	.28	.29½
MOP*	lb.	.29	.30½
Dioctyl Adipate (dms.)	lb.	.42½	.43½
Dioctyl Phthalate (dms.)	lb.	.27½	.29
Dioctyl Sebacate (dms.)	lb.	.61¼	.62¼
D.I.O.P. (dms.)	lb.	.27½	.29
Dipolymer Oil	gal.	.33	.48
Dispersing Oil No. 10*	lb.	.06	.06¼
Dutrex* 1, 6, 7	gal.	.18	.23
6H	gal.	.13	—
15E	gal.	.11	.23
20, 25	lb.	.03	.06
33	gal.	.21	.33
Elastex 10-P*	lb.	.30½	.33½
50-B*	lb.	.25	.28
DCHP*	lb.	.59	.60
Emulphor EL-719*	lb.	—	.58
Epoxy Plasticizer	lb.	.33½	.36
Drapex 3.2*	lb.	.39¼	.40¼
Drapex 4.4*	lb.	.34¾	.35¾
Drapex 7.7*	lb.	.37	.38
Esparto Wax	lb.	—	.55
Estac*	lb.	—	.16
Facile Gum 4A*	lb.	.48	.50
Flexol B-400*	lb.	.29	.30
DOP*	lb.	.29	.30½
TOF*	lb.	.47	.48
3GH*	lb.	—	.46¾
3GO*	lb.	—	.55¾
4GO*	lb.	—	.36½
426*	lb.	.28½	.30
Flexricin P-1*	lb.	.33½	.36½
P-4*	lb.	.30½	.33¼
P-6*	lb.	.37	.40
P-8*	lb.	.30¼	.33¼
Fortex A* (dms.)	lb.	.12½	.14½
Fura-Tone NC-1008*	lb.	.28	.39
Galex W-100*	lb.	.15½	.19¼
Good-rite GP233*	lb.	.40	.43½
GP235*	lb.	.40	.43½
GP236*	lb.	.40	.43½
GP261*	lb.	.28	.31½
GP265*	lb.	.28½	.32
GP266*	lb.	.29	.32½
GP-266-BPA*	lb.	.29	.32½
Hallco C-255-NS*	gal.	.27½	.29½
C-566*	lb.	.11	.13
Harflex 300* (dms.)	lb.	.60½	.61
325* (dms.)	lb.	.45	.45½
375* (dms.)	lb.	.76	.76½
500* (dms.)	lb.	.34	.35
HB20*	lb.	.17	.18½
HB40*	lb.	.21½	.23
Herron-H.T.*	gal.	.16	.27
Herron-Plas*	lb.	—	.03¾
Herron-Wax*	lb.	.05¼	.06
No. 23*	lb.	.08¼	.08¾
No. 24*	lb.	.07¼	.07¾
HSC No. 13*	lb.	.25	.32
No. 28 and 38*	lb.	.20	.27
Indonex 632½* (633½*, 634½*, 637½*)	gal.	.12	.19
Isooctyl Decyl Phthalate (dms.)	lb.	.28	.29½
Kapsol*	lb.	.35	.35½
Kenflex A & N*	lb.	.19	.34
Kesscoflex BCL* (dms.)	lb.	—	.37
BCO* (dms.)	lb.	—	.33
BCP* (dms.)	lb.	—	.36
BCS* (dms.)	lb.	—	.32
BO* (dms.)	lb.	—	.28¼
BS* (dms.)	lb.	—	.27½
DBT* (dms.)	lb.	—	.68
DIOA* (dms.)	lb.	—	.43½
DOA* (dms.)	lb.	—	.43½
MCO* (dms.)	lb.	—	.35½
MCP* (dms.)	lb.	—	.41
MCS* (dms.)	lb.	—	.35
TRA* (dms.)	lb.	—	.40

PLASTICIZERS & SOFTENERS (Cont'd)

KP 23*	lb.	.32½	.33½
90*	lb.	.42½	.43½
140*	lb.	.48	.48½
201*	lb.	.45	.46½
260*	lb.	.36½	.37½
Kremol 40*	gal.	.36	.46
50*	gal.	.39	.49
Kromsol* (dms.)	lb.	.36½	.37½
Kronitex AA* (dms.)	lb.	.35	.36
I, K-3, MX*	lb.	.35	.36
Lanolin, Tech. Anhydrous	lb.	—	.20
Latex-Lube G.R.*	lb.	.19¼	.20
Lead Oleate	lb.	—	.29¾
Lindol* (dms., t.c.)	lb.	—	.32½
Locusol No. 1-6980*	lb.	.30	.34
2-Mercaptoethanol (dms.)	lb.	1.25	1.50
Methox*	lb.	.39½	.40
Methyl Laurate	lb.	.25	.27
Methyl Oleate	lb.	—	.20
Methyl Stearate (dms.)	lb.	—	.30
Monoplex DOS*	lb.	.59½	.60½
DBS*	lb.	.65½	.66½
S-70*	lb.	.41	.42
S-71*	lb.	.46½	.47½
Montan Wax, Crude	lb.	.21	.26
Flaked	lb.	.29	.29
Morflex*	lb.	.32	.69½
Natac*	lb.	.1535	.1635
Nebony Resins* (dms.)	lb.	.04½	.05½
Neolene 210* (t.c.)	lb.	—	.16
212* (t.c.)	lb.	—	.14
220* (t.c.)	lb.	—	.15
Nerium*	lb.	—	.09
Nevillac Resins* (dms.)	lb.	.31	.85
Neville LX-880* (dms.)	lb.	.12	.13½
LX-685* (dms.)	lb.	.12	.17½
LX-782 (dms.)	lb.	.07½	.08½
LX-828* (dms.)	lb.	.11	.12½
LX-1000* (dms.)	lb.	.12	.13
Neville Resins* (dms.)	lb.	.07¼	.20
Nevindene Resins* (dms.)	lb.	.16½	.20
Nevinol* (dms.)	lb.	—	.24
No. 480 Oil Proof Resin*	lb.	—	.18
Ohopex Q10* (dms.)	lb.	.29	.30½
R9* (dms.)	lb.	.37¾	.37¾
OPD*	lb.	.29	.40
Ortho-Nitrobiphenyl	lb.	.13	.15
Ozokerite Wax, White and Yellow	lb.	.24	.31
Paradene Resins (dms.)	lb.	.07¾	.08
No. 2 Flaked	lb.	.08	.08½
Para Flux* (dms.)	gal.	.22	.25
2016* (dms.)	gal.	.22	.26
Para Lube* (t.c.l.)	lb.	.046	.048
Paraplex G-25*	lb.	.76	.77
G-40*	lb.	.50	.51
G-50*	lb.	.40¾	.41¾
G-53*	lb.	.45	.46
G-60* (and G-61*)	lb.	.35	.36
G-62*	lb.	.37	.38
Parmo*	lb.	.06	.13¼
Peroxidol 780*	lb.	.33½	.36¼
781*	lb.	.34¾	.37¾
Petroflux MV*	gal.	.097	.177
Petrolatum (dms.)	lb.	.04¼	.14¾
PG-16*	lb.	—	.35
Philrich-5* (t.c.)	gal.	—	.12¼
Picco 10* (and 25*)	lb.	.15	.15½
60* (and 75*)	lb.	.14½	.15
100*	lb.	.14½	.17
Piccocizer 30*	lb.	.05½	.07
Piccolastic A* (B*, C*, D* & E*)	lb.	.24	.25
FT* (FHX* & FX*)	lb.	.1695	.1745
T-135*	lb.	.19	.20
Piccolyte S Resins*	lb.	.20½	.23½
Piccopale Resins*	lb.	.12	.13
Piccoumaron Resins*	lb.	.07	.24½
Pigmentar* Pigmentaroil*	lb.	.510	.684
Pitt-Consol 500* (dms.)	lb.	.30	.30½
Plastac M*	lb.	—	.09¼
Plasticizer 2286*	lb.	—	.26¼
Plasticizer 4141*	lb.	.42½	.43½
Plasticizer DP-200. DP-250. DP-520*	lb.	.45	.45¾
DP-316*	lb.	.32¾	.33½
DP-317*	lb.	.46	.47¼
DP-8732*	lb.	.44¾	.46
Plasticizer LP*	lb.	—	.07
Plasticizer MP*	lb.	—	.08
Plasticizer MT-511*	lb.	—	.68¾
Plasticizer ODN*	lb.	.35	.41
Plasticizer SC*	lb.	.40½	.42
Plasticizer W-13*	lb.	.37	.38¾
Plastoflex 3*	lb.	—	.52
52*	lb.	.37¾	.38¾
VS*	lb.	.41¾	.42¾
Plastogen*	lb.	.08¾	.09
Plastolein 9050* (c.l.)	lb.	.54½	.56½
9055*	lb.	.30½	.32½
9058*	lb.	.48	.50
9250*	lb.	.38¼	.40¼
9715*	lb.	.39	.40
Plastone	lb.	.23	.27
Polycizer 162*	lb.	.27½	.28½
332*	lb.	.29	.32½
562*	lb.	.28	.29
662*	lb.	.28	.29½
532 and 632*	lb.	.40	.41¾
ED*	lb.	—	.51
Polyco 438*	lb.	.34	.35
Polymel C-130*	lb.	.13¼	.14¼
D*	lb.	.22½	.23½
6*	lb.	.05¾	.07¾
Poly-Sperse AP-2	lb.	.23	.29½
AP-300, LC-20	lb.	.26	.32½
Poly-Sperse R-100	lb.	.17	.23½

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Process Oil C-255* (c.l.)	gal.	.27½	.29½
Propylene Stearate (dms.)	lb.	—	.32
PRR 1*	gal.	.15	.35
PT 101 Pine Tar Oil* (t.c., dms.)	lb.	.0380	.0554
400 Pine Tar* (600* & 800*) (t.c., dms.)	lb.	.0380	.0554
PX-104*	lb.	.30	.32½
PX-108*	lb.	.30½	.33
PX-138*	lb.	.32½	.33½
PX-208* & 238*	lb.	.44½	.45½
PX-404*	lb.	.66	.67
PX-438*	lb.	.60	.61
PX-800*	lb.	.34	.35
PX-917*	lb.	.36½	.37½
RC Plasticizer B-17* (dms.)	lb.	.23½	.24½
O-16* (dms.)	lb.	.30	.31
TG-8*&TG-9* (dms.)	lb.	.34½	.35½
TG-85* (dms.)	lb.	.36½	.37½
RC Polymeric BGA* (dms.)	lb.	.45½	.46½
Reogen*	lb.	.14¼	.14½
Resin C*	lb.	.0225	.0310
Resinex*	lb.	.03¾	.05¼
L-4*	lb.	.02½	.04½
Rexflex*	lb.	—	.15
Rosin Oil	gal.	.80	1.35
RR-10 (Neoprene)*	lb.	—	.37
R.S.O. Softening Oil*	lb.	.03	.05
RuBars*	lb.	.19¼	.20
Rubberol*	lb.	.18	.25¾
Santicizer B-16*	lb.	.46¾	.47¾
E-15*	lb.	.53	.54
M-17*	lb.	.44	.45
No. 140*	lb.	.35	.36
No. 141*	lb.	.36½	.37½
No. 160*	lb.	.27½	.29
No. 602*	lb.	—	.28½
No. 603*	lb.	.27	—
Sherolatum*	lb.	.03½	.06
Staflex DBES*	lb.	.58½	.61½
DOS*	lb.	.59¼	.62¼
IXA*	lb.	.32	.35
KA*	lb.	.34	.36¾
Stan Chlor Oils*	lb.	.13½	.20½
70*	lb.	.17½	.30
Stanolind Petrolatum*	lb.	.07	.156
Wax*	lb.	.31	.33
Sunny South Burgundy Pitch*	lb.	.123	.1285
Rosin Oil*	gal.	.605	.76
Superla Wax*	lb.	.30	.397
Syncera Wax*	lb.	.16	.267
Syn Tac* (c.l.)	gal.	—	.33
Synthetic Revertant Oil	lb.	—	.16
Tar, Refined	gal.	.1200	.1760
Tarpine	lb.	.035	.050
Terpene A*	gal.	—	.65
Tetraflex R-122*	lb.	.27	.30½
TP-90B*	lb.	.59	.69
TP-95*	lb.	.65	.75
Transphalt Resins*	lb.	.03¾	.05¾
Tributyl Phosphate	lb.	.52½	.53½
Tricresyl Phosphate	lb.	.35	.36
Triphenyl Phosphate	lb.	.41½	.43½
Turgum S*	lb.	.141	.151
Turgum SB*	lb.	.09½	.10½
Turpol NC-1200*	lb.	.67	.70
NC-1300*	lb.	—	.50
Vistac No. 1*	gal.	1.00	1.21
P*	lb.	.18	.18½
Vopcolene 50*	lb.	—	.31
Witcizer 100*	lb.	.26	.27
200*	lb.	.22¼	.25¼
300*	lb.	.30	.33½
312*, 313*	lb.	.28	.31½
412*	lb.	.42½	.46

PROCESSING AIDS

Castor Oil, Blown (dms.)	lb.	.26½	.27½
Refined (dms.)	lb.	—	.18½
Castorwax*	lb.	.25	.31
Dutrex 7*	lb.	.12	.20
ELA*	lb.	—	.82
Foamnix*	lb.	.60	1.50
Hydrofol Glycerides 200*	lb.	.15½	.19¾
Kenflex N*	lb.	.19	.26
Maleic Anhydride	lb.	—	.27
Millrex*	lb.	—	.15
Nadic Anhydride	lb.	—	.75
Polycin*	lb.	—	.24½
R-B-H Resin 510*	lb.	.19	.26
530*	lb.	.25	.32
STAYB*	lb.	.25	.45
Thiomalic Acid	lb.	—	3.50
Webnix*	lb.	1.25	2.00
Zyrox*	lb.	.78	.88

PROTECTIVE & STABILIZING AGENTS

Acacia*	lb.	.12¾	.21
Alcogum*	lb.	.08½	.24
Alpha Protein	lb.	—	.23
Arroostoocrat*	lb.	—	.07½
Carob Bean Flour	lb.	—	.50
Casein	lb.	.22	.35
Emcol K-8300* (dms.)	lb.	.14	.18
Ethylene Diamine 68%	lb.	.44	.47
Gum Arabic	lb.	—	.23
Karaya Gum	lb.	—	.35
Locust Bean Gum	lb.	—	.50
Prosein*	lb.	—	.06
Stablex B*	lb.	.50	.95
K*	lb.	.27	.35

RECLAIMING AGENTS

Amalgamator Z-4*	lb.	.34	.35
Armeen C*	lb.	.46	.52
Mixed Crude*	lb.	.19	.25
T*	lb.	.32	.38
Blend No. 27 Oil	gal.	.35	.42
Burco RA*	lb.	.05	.081
BWH-1*	gal.	.16	.17
C-6 Oil* (28* & 34*)	gal.	.33	.38
C-10 Oil*	gal.	.25	.30
C-33* (t.c.)	gal.	—	.21½
C-42* (t.c.)	gal.	—	.23
Caustic Soda—Flake 76% (c.l., dms.)	cwt.	—	5.20
Liquid 50% (t.c.)	cwt.	—	2.90
Solid 76% (c.l., dms.)	cwt.	—	4.80
Cresylic Acid (99-100%)	gal.	.85	1.39
D-4* (t.c.)	gal.	—	.27
E-5* (t.c.)	gal.	—	.25
Flake Calcium Chloride (77-80%)	ton	—	31.00
(94-97%)	ton	—	39.80
Gensol No. 6* (t.c.)	gal.	—	.42
Heavy Aromatic Naphtha	gal.	.13¼	.18½
LX-572 Reclaiming Oil*	gal.	.27	.32
LX-777 Reclaiming Oil*	gal.	.23	.33
Neo-Fat D-242*	lb.	.05½	.07¾
42-70*	lb.	.08¼	.10¼
No. 517 H.B. Oil*	gal.	.11½	.16½
535*	gal.	.22	.27
Nucom* (t.c.)	gal.	—	.42
Pitt-Consol 500 (dms.)	lb.	.30	.30½
640 (dms.)	lb.	.42	.42
PT 101 Pine Tar Oil* (t.c., dms.)	lb.	.0380	.0554
Q Oil* (t.c.)	gal.	—	.286
Reclaiming Oil 3186 G*	gal.	.26	.33
Reclaiming Reagent No. 1431*	lb.	.21	.25
R.P.A. No. 3*	lb.	—	.51
RR-10*	lb.	—	.3*
Soda Ash (c.l., bags)	cwt.	—	1.85
Solvent 534*	gal.	.20½	.26½
Solvent Oil 21*	gal.	.24	.29
C-42*	gal.	.23	.3[illegible]
701 Oil*	gal.	.27	.29

REINFORCING AGENTS—CARBON BLACK

Channel, Hard Processing (HPC) (bags)

Dixiedensed (and S)*	lb.	.0775	.1550
Kosmobile (and S)*	lb.	.0775	.1550

Channel, Medium Processing (MPC) (bags)

Arrow MPC*	lb.	.0850	.1625
Continental A*	lb.	.0850	.1625
Dixiedensed HR (and S-66)	lb.	.0850	.1625
Kosmobile HM (and S-66)	lb.	.0850	.1625
Micronex Standard*	lb.	.0850	.1625
Spheron 6*	lb.	.0850	.1625
Texas M*	lb.	.0850	.1625
Witco No. 1*	lb.	.0850	.1625

Channel, Easy Processing (EPC) (bags)

Collocarb*	lb.	.0710	.1485
Continental AA*	lb.	.0850	.1625
Dixiedensed 77*	lb.	.0850	.1625
Kosmobile 77*	lb.	.0850	.1625
Micronex W-6*	lb.	.0850	.1625
Spheron 9*	lb.	.0850	.1625
Texas E*	lb.	.0850	.1625
Witco No. 12*	lb.	.0850	.1625
Wyex EPC*	lb.	.0850	.1625

Channel, Conductive (CC) (bags)

Continental R-40*	lb.	.2600	.3500
Dixie 5 Dustless*	lb.	.1350	.2200
Dixie Voltex*	lb.	.2600	.3500
Kosmink Dustless*	lb.	.1350	.2200
Kosmos Voltex	lb.	.2600	.3500
Texas MC-74-BD*	lb.	.2600	.3500
Voltex*	lb.	.2600	.3500

Conductive Furnace Black (CF) (bags)

Aromex CF*	lb.	.0875	.1550
Continex CF*	lb.	.1100	.1700
Dixie CF*	lb.	.0925	.1600
Kosmos CF*	lb.	.0925	.1600
Shawinigan Acetylene Black*	lb.	—	.1900
Vulcan C*	lb.	.1100	.1850

Extra-Conductive Furnace Black (ECF) (bags)

Vulcan XC-72 (pellets)*	lb.	.2500	.3400

REINFORCING AGENTS—CARBON BLACK (Cont'd)

Furnace, Fast Extruding (FEF) (bags)

Arovel FEF*	lb.	.0675	.1350
Continex FEF*	lb.	.0675	.1350
Dixie 50*	lb.	.0675	.1350
Kosmos 50*	lb.	.0675	.1350
Philblack A*	lb.	.0675	.1350
Statex M*	lb.	.0675	.1350
Sterling SO*	lb.	.0675	.1350

Furnace, Fine (FF) (bags)

Statex B*	lb.	.0725	.1400
Sterling 99*	lb.	.0725	.1400

Furnace, General Purpose (GPF) (bags)

Arogen GPF*	lb.	.0600	.1275
Continex GPF*	lb.	.0600	.1275
Dixie 35*	lb.	.0600	.1275
Kosmos 35*	lb.	.0600	.1275
Statex G*	lb.	.0600	.1275
Sterling V*	lb.	.0600	.1275
V (Non-Staining)	lb.	.0600	.1275

Furnace, High Abrasion (HAF) (bags)

Aromex HAF*	lb.	.0775	.1450
Continex HAF*	lb.	.0775	.1450
Dixie 60*	lb.	.0775	.1450
Kosmos 60*	lb.	.0775	.1450
Philblack O*	lb.	.0775	.1450
Statex R*	lb.	.0775	.1450
Vulcan 3*	lb.	.0775	.1450

Furnace, High Modulus (HMF) (bags)

Continex HMF*	lb.	.0625	.1300
Dixie 40*	lb.	.0625	.1300
Kosmos 40*	lb.	.0625	.1300
Modulex HMF*	lb.	.0625	.1300
Statex 93*	lb.	.0625	.1300
Sterling L*	lb.	.0625	.1300
LL*	lb.	.0625	.1300

Furnace, Semi-Reinforcing (SRF) (bags)

Continex SRF*	lb.	.0575	.1250
Dixie 20*	lb.	.0575	.1250
Essex SRF*	lb.	.0575	.1250
Furnex*	lb.	.0575	.1250
Gastex*	lb.	.0625	.1350
Kosmos 20*	lb.	.0575	.1250
Pelletex*	lb.	.0575	.1250
NS*	lb.	.0575	.1250
Shawinigan Acetylene Black*	lb.	—	.1900
Sterling NS*	lb.	.0575	.1250
R*	lb.	.0625	.1350
S*	lb.	.0575	.1250

Furnace Super Abrasion (SAF) (bags)

Dixie 85	lb.	.1150	.1750
Kosmos 85	lb.	.1150	.1750
Philblack E*	lb.	.1150	.1900
Statex 160*	lb.	.1150	.1900
Vulcan 9*	lb.	.1150	.1900

Furnace, Super Abrasion, Intermediate (ISAF) (bags)

Aromex ISAF*	lb.	.0925	.1600
Continex ISAF*	lb.	.0925	.1600
Dixie 70*	lb.	.0925	.1600
Kosmos 70*	lb.	.0925	.1600
Philblack I*	lb.	.0925	.1600
Statex 125*	lb.	.0925	.1600
Vulcan 6*	lb.	.0925	.1600

Furnace, Super Conductive (SCF) (bags)

Conductex SC*	lb.	.1150	.1800
Vulcan SC*	lb.	.1800	.2550

Thermal, Fine (FT) (bags)

P-33 (c.l.)*	lb.	—	.0625
Sterling FT (c.l.)*	lb.	—	.0575

Thermal, Medium (MT) (bags)

Sheilblack*(†)	lb.	—	.0250
Sterling MT (c.l.)*	lb.	—	.0400
MT Non-Staining (c.l.)*	lb.	—	.0500
Thermax (c.l.)*	lb.	—	.0450
Stainless (c.l.)	lb.	—	.0550

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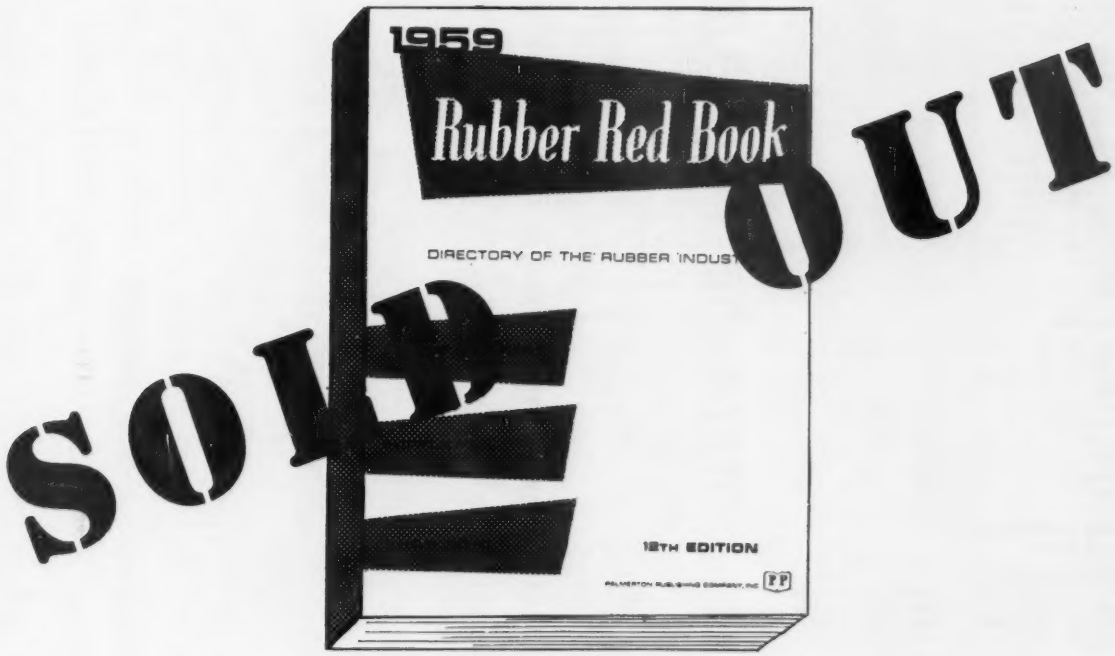

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Cab-o-sil*	lb.	.66	1.25
D. C. Silica (pelletized)*	lb.	1.45	1.65
Hi-Sil 233*	lb.	.08¼	.09¼
X303*	lb.	.50	.60
Santocel*	lb.	.62	.64
Ultrasil VN-3*	lb.	.35	.65
Valron Estersil*	lb.	2.00	2.25

REINFORCING AGENTS—MISCELLANEOUS

Angelo Shellac*	lb.	.40	.50
Cato* (bags)	lb.	17.00	17.15
Darex Copolymer No. 3*	lb.	.47	.49
43G*	lb.	.39	.41
Darex Copolymer Latex No. 3-L	lb.	.41½	.46
Durez 12687 (and 12707)*	lb.	.36½	.40
Durez 13355*	lb.	.27½	.31½
Good-rite Resin 2007*	lb.	.36	.38
2057*	lb.	.30	.31
Hystron*	lb.	.39	.41
Kralac A-EP*	lb.	.39	.41
Lampblack	lb.	—	.12
Marbon 8000*	lb.	.36	.43
Marmix*	lb.	.35	.43
Mistron Vapor*	lb.	—	.03½
HGO-55*	lb.	—	.05
Pliolite Latex 150*	lb.	.35	.39
Pliolite Resin-Rubber Masterbatches*	lb.	.33	.57
Pliolite NR*	lb.	.93	.95
S6B*	lb.	.36	.43
Plio-Tuf G85C*	lb.	.52	.54
Polyco 220*	lb.	.18¼	.19¼
Poly-Phen 201-C; 218-C	lb.	.27½	.29
202-C	lb.	.36	.37½
Polypol S-70*	lb.	.25	.26

RETARDERS

Akron Benzoic Acid TBAO-2*	lb.	.41	.43
Dutch Boy Normasal*	lb.	—	.46
ESEN*	lb.	.39	.41
Good-rite Vultrol*	lb.	.67	.70
Harcopol 1183*	lb.	.70	.74
Retarder J*	lb.	.68	.70
PD*	lb.	.39	.41
W*	lb.	—	.46
Retardex*	lb.	.46	.46
Wiltrol P	lb.	.37	.39

RUBBER SUBSTITUTES

Mineral Rubber

Byerlyte*	ton	55.00	62.00
Hard Hydrocarbon (dms.)*	ton	53.00	60.00
Herron Flake*	ton	—	45.00
Mineral Rubber, Solid	ton	42.50	44.50
M. R. No. 38*	ton	57.00	70.00

Vulcanized Vegetable Oils

Amberex*	lb.	.29	.36
Brown	lb.	.15	.24
Car-Bel-Lite*	lb.	.33½	.36
Neophax*	lb.	.17	.27
Car-Bel-Rez A and C*	lb.	.126	.1685
White	lb.	.15	.26
670 Brown	lb.	.14¼	.14¾

Miscellaneous Rubber Substitutes

Gilsowax B*	lb.	.09	.11
Resin No. 1098 (dms.)	lb.	—	.62
No. 1198*	lb.	.46¾	.49¾
Tysonite*	lb.	.26	.26¾

SOLVENTS

Acetone (dlvd.)	lb.	.11	.12½
Amsco Lactol Spirits* (t.c.)	gal.	—	.20
Naphthol Spirits*	gal.	—	.19
Mineral Spirits*	gal.	—	.18
Rubber Solvent* (t.c.)	gal.	—	.19
Solv A* (t.c.)	gal.	—	.22
Solv A-80* (t.c.)	gal.	—	.23½
Solv B* (t.c)	gal.	—	.28
Solv B-90* (t.c.)	gal.	—	.31
Solv D* (t.c.)	gal.	—	.30
Solv E*	gal.	—	.30
Solv F*	gal.	—	.30
Solv F-80*	gal.	—	.32
Solv G*	gal.	—	.36
Special Naphtholite* (t.c.)	gal.	—	.19
Special Textile Spirits*	gal.	—	.20
Super Hi-Flash Naphtha*	gal.	—	.34
Super Naphtholite*	gal.	—	.19
Textile Spirits* (t.c.)	gal.	—	.20
Amyl Chlorides, Mixed (l.c.l.) (dms.)	lb.	—	.11
Benzol 90%	gal.	.36	.40
Butyl Acetate	lb.	.17	.18½
Butyl Alcohol	lb.	.17	.19¼
Secondary (dlvd.)	lb.	.15	.16½
Tertiary (dlvd.)	lb.	.15	.16½
Carbon Bisulfide, Tech.	lb.	.07	.08½
Carbon Tetrachloride	lb.	.10¾	.14¼
Cosol 1*	gal.	.37	.43
2*	gal.	.42	.48
Cyclohexane	gal.	.77	110.00
85% (c.l.) (dms.)	gal.	—	.56

SOLVENTS (Cont'd)

Cyclohexanone	lb.	.29	.31½
Diacetone, Pure (dlvd.)	lb.	.15½	.17
Dichlorethyl Ether (dms.)	lb.	.15½	.16½
Dichloropentanes (l.c.l.) (dms.)	lb.	—	.06
Dicom*	gal.	—	.55
Halowax Oil*	lb.	.28	.41
Heptanes* (t.c.)	gal.	—	.1609
Hexanes (t.c.)	gal.	—	.1584
Isobutyl Acetate	lb.	.15¼	.16¾
Isopropyl Alcohol, Ref. 99% (dlvd.)	gal.	.62	.72
Ether, Ref. (dlvd.)	lb.	.09½	.11
Mersol*	gal.	.43	.79
Mesityl Oxide (dlvd.)	lb.	.15	.16½
Methyl Acetone, Syn. (dms., dlvd.)	gal.	.66	.72
Methyl Chloride	lb.	—	.12¾
Methyl Ethyl Ketone	lb.	.15	.16½
Methyl Isobutyl Ketone (dlvd.)	lb.	.17	.18½
Methylene Chloride	lb.	—	.12½
N-5 Pentane Mix* (t.c.)	gal.	—	.13½
N-6 Hexanes* (t.c.)	gal.	—	.14½
N-7 Hexanes* (t.c.)	gal.	—	.13½
Nelio Dipentene	gal.	.41	.62
Penetrell*	gal.	.41	.42
Perchlorethylene	lb.	.11¾	.15¼
Petrolene* (t.c.)	gal.	—	.14125
Picolines, Alpha, Refined	lb.	.43½	.44
Mixed	lb.	.32½	.33
Proprietary Solvent (dms.)	gal.	.66	.77
Propyl Acetate (t.c., dlvd.)	lb.	—	.11¾
Alcohol (t.c., dlvd.)	lb.	—	.11
Pyridine, Refined	lb.	.74½	.75
Quinoline	lb.	.50	.54¼
Rubber Solvent (t.c.)	gal.	—	.16
Rubsol (t.c.)	gal.	—	.12875
Skellysolve B (Hexanes)* (t.c.)	gal.	—	.16
C (Heptanes)* (t.c.)	gal.	—	.16¼
R (Rubber Solvent)*	gal.	—	.1390
Solvent, Crude, Light	gal.	.19	.28
Solvesso 100* (t.c.)	gal.	.33	.35
150 (t.c.)	gal.	.33	—
Sunny South DD Dipentine*	gal.	.41	.62
Sunny South DD Pine Oil*	lb.	—	.15
Sunray*	gal.	.1140	.1600
Toluene (dms.)	gal.	—	.38
Toluol (t.c.)	gal.	.33	.35
Trichlorethane	lb.	—	.12¾
Trichlorethylene	lb.	.12	.16¾
Trigiycol Dichloride	lb.	.63	.64
Union Thinner 1* (t.c.)	gal.	—	.174
5* (dms.)	gal.	—	.199
7* (t.c.)	gal.	—	.164
2-50 W Hi-Flash*	gal.	—	.41
Xylol	gal.	.34	.38

STABILIZING AGENTS (for Vinyl Resins)

Advastab BC-12*	lb.	.90	.95
BC-74*	lb.	.70	.75
BC-105*	lb.	.75	.80
CH-101*; CH-201*	lb.	.60	.65
E-82*	lb.	.90	.95
JCX*	lb.	.62	.67
L Paste*	lb.	.65	.70
SN*	lb.	.47	.52
T-10*	lb.	1.90	1.95
T-50-LT*	lb.	3.20	3.25
XBZ-155*	lb.	.69	.74
XC-143*	lb.	.90	.95
XE-98*	lb.	.53	.58
Amioca 50* 85* (bags)	lb.	11.11	11.26
Barca 10*	lb.	.65	.70
Barium Ricinoleate (BVS)	lb.	—	.70
Barium Stearate	lb.	.41	.46
Basic Silicate White Lead	lb.	.16	.17
Cadmium Ricinoleate	lb.	—	2.00
Calcium Ricinoleate	lb.	—	.55
Dutch Boy DS-207*	lb.	—	.54
Plumb-O-Sil A*	lb.	—	.29¾
B*	lb.	—	.31¾
Tribase*	lb.	—	.26½
Dythal*	lb.	—	.39½
Ferro 182* (dms.)	lb.	.70	.76
200* (dms.)	lb.	1.33	1.43
203* (dms.)	lb.	.87	.91
541* (dms.)	lb.	.35½	.45½
541A* (dms.)	lb.	.82	.86
700* (dms.)	lb.	.48¾	.58¾
900* (dms.)	lb.	.90	.94
903* (dms.)	lb.	.60	.64
909* (dms.)	lb.	.91	.95
920*	lb.	—	.98
931* (dms.)	lb.	.75¾	.85¾
993* (dms.)	lb.	.89	.99
1203* (dms.)	lb.	1.30	1.40
1206* (dms.)	lb.	1.32	1.36
1820* (dms.)	lb.	.90	.94
1825* (dms.)	lb.	1.00	1.04
1976*	lb.	.47	.51
Harshaw 1-V-3*	lb.	.43	.45
1-V-4*	lb.	.68	.70
1-V-7*	lb.	.70	.72
2-V-4*	lb.	.85	.87
2-V-8*	lb.	1.31	1.33
5-V-1*	lb.	.41	.43

STABILIZING AGENTS (Cont'd)

Harshaw 7-V-2*	lb.	.93	.95
8-V-1*	lb.	.82	.84
8-V-100*	lb.	.82	.84
9-V-1*	lb.	.70	.72
12-V-5*	lb.	.73	.75
24-V-1*	lb.	1.10	1.12
128-V-5*	lb.	.86	.88
Kosol* (bags)	lb.	19.00	19.50
Lithium Stearate	lb.	.52	.57
Fluffy	lb.	.47½	.70
Standard	lb.	.52½	.75
Mark A*	lb.	2.80	3.15
C*	lb.	.81	.84
E*	lb.	.72	.75
GS*	lb.	.77	.80
LL*	lb.	.59	.62
KCB*	lb.	.59	.62
M*	lb.	.59	.62
PL*	lb.	.62	.65
TT*	lb.	.72	.75
WS*	lb.	.97	1.00
X*	lb.	2.50	2.75
XI*	lb.	.87	.90
XV*	lb.	.84	.87
XX*	lb.	.57	.60
33*; 34*; 35*	lb.	.97	1.00
Metasap 613-A*	lb.	—	.69
613-B*	lb.	—	.84
613-C*	lb.	—	1.06
621*	lb.	—	.88
624*	lb.	—	.75
633*	lb.	—	.75
635*	lb.	—	.45
Modicol N*	lb.	.42½	.44½
S*	lb.	.30⅞	.32⅞
Sodium Silicates 41°/1:32	cwt.	1.20	2.30
Stabelan E*	lb.	1.40	1.50
XL*	lb.	.55	.65
HR-50*	lb.	.75	.90
HR Liquid*	lb.	.65	.75
HR Paste*	lb.	.85	.95
HR Powder*	lb.	.95	1.05
No. 110 Liquid	lb.	.65	.75
Istabelan No. 115 Liquid	lb.	.85	.95
No. 120 Liquid	lb.	.65	.75
Stabilizer No. 52*	lb.	1.90	2.00
89X*	lb.	.75	.80
B-5*	lb.	—	.70
E6B*	lb.	—	.95
G-1*	lb.	1.25	1.40
HR*	lb.	.85	.89
L*	lb.	—	.60
OM-10*	lb.	—	1.95
Staflex OY*	lb.	1.00	1.20
QXMA*	lb.	—	.70
Stayrite 10*	lb.	.36	.41
P-10*	lb.	.43	.45
15*	lb.	.55	.57
20*	lb.	.41	.46
22*	lb.	1.00	1.13
25*	lb.	.35	.40
70*	lb.	.70	.72
71*	lb.	.90	.92
75*	lb.	.61	.63
76*	lb.	.53	.55
80*; 90*	lb.	.70	.72
95*	lb.	.70	.72
229*	lb.	.61	.63
Vanstay A* (dms.)	lb.	.50	.53
AB* (dms.)	lb.	.46	.49
AC* (dms.)	lb.	.45	.48
CE* (dms.)	lb.	.44	.47
HT* (dms.)	lb.	.87	.90
HTA* (dms.)	lb.	.97	1.00
HTB* (dms.)	lb.	.70	.73
HTC* (dms.)	lb.	1.09	1.12
HTE* (dms.)	lb.	.80	.83
L* (dms.)	lb.	.32	.35
R* (dms.)	lb.	.67	.70
RR* (dms.)	lb.	.59	.62
RZ-25* (dms.)	lb.	.65	.69
S* (dms.)	lb.	.57	.60
SA* (dms.)	lb.	.81	.84
W* (dms.)	lb.	1.22	1.25
Z* (dms.)	lb.	.62	.65

STIFFENING AGENTS

Polyac*	lb.	—	1.85
Processinfi Stiffener 710*	lb.	.88	.90
Solvitose HDF, H. C-S, T, and E*	lb.	.22	.25
Versatil Gum 8-E*	lb.	.15	.19

SUN CHECKING AGENTS

Allied AA-1144*	lb.	.23	.24
AA-1177*	lb.	.15½	.16½
Antisol*	lb.	—	.23
Antisun* (Chipped)	lb.	.15½	.17½
(Slabbed)	lb.	.15	.17
Heliozone*	lb.	.31	.32
Microflake*	lb.	.20	.24
Nacconol NRSF*	lb.	.40½	.45
NBC*	lb.	—	1.67
Ross Sunproofing Waxes*	lb.	—	.15
Sunolite*	lb.	.16	.22
127*	lb.	.16½	.20½
154*	lb.	.23	.25
Sunproof*	lb.	.32	.33
Improved*	lb.	.25	.26
Super*	lb.	.41	.42
Jr.*	lb.	.22	.23
Tonox*	lb.	.54	.56

SURFACE ACTIVE AGENTS

Anhydrapent*	lb.	.56	.59
Anhydrol 6990*	lb.	.51	.56
6991*	lb.	.51	.56
Aquarex D*	lb.	—	.81
G*	lb.	—	.21
MDL*	lb.	—	.33
ME*	lb.	—	.82
NS*	lb.	—	.60
SMO*	lb.	—	.50
WAQ*	lb.	—	.22
Emulphor EL-620*	lb.	—	.40
EL-719*	lb.	—	.58
ON-870*	lb.	—	.55
Hyonics*	lb.	—	.28¾
Igepal CA-630	lb.	—	.29
CO-630; CO-730*	lb.	—	.29
CO-850; CO-880*	lb.	—	.29
Igepon CN-42*	lb.	—	.25
T-33*	lb.	—	.21
T-51*	lb.	—	.13½
T-77*	lb.	—	.49
Kessco 50201*	lb.	—	.44½
50203*	lb.	—	.44¼
18201*	lb.	—	.32
18203*	lb.	—	.35½
Lipal 9-N,* 11-0*	lb.	.28	.29
8-0,* 6-0*	lb.	.29	.30
25C,* 52C*	lb.	.34	.35
15T*	lb.	.23	.24
Pluronic L62*	lb.	.33½	.39
L64*	lb.	.33½	.39
Sellogen Gel*	lb.	—	.12¾
Soybean Lecithin	lb.	.13	.17
Synatol AV-60*	lb.	.28	.29

TACKIFIERS

Amalgamator Z-4*	lb.	.34	.35
Arcco 620-32B*	lb.	.20½	.21½
716-30*	lb.	.18½	.19½
1041-21*	lb.	.16½	.17½
Arcco A-2e*	lb.	.18	.19
Bunaweld Polymer No. 780*	lb.	—	.24
No. 5514*	lb.	—	.35
Galex* (dms.)	lb.	.17¼	.20
Indopol H-300*	gal.	1.00	1.22
Koresin*	lb.	1.13	1.15
Liquid Rubber Flux*	lb.	—	.14
Nacconal NRSF* (dlvd.)	lb.	.40½	.45
Nilox Resin* (c.l.)	cwt.	—	16.00
OPD*	lb.	.29	.40
PR-162 Resin Emulsion	lb.	.82	—
Resin V	lb.	—	.23½
Synthol*	lb.	.17	.24¾
Vistac A*	lb.	.21½	.22¼
Vistanex LM Grades*	lb.	—	.45
Zirex* (c.l.)	cwt.	—	15.25
82 Resin Solid (dms.)	lb.	.13½	.14½
84 Resin Solid (dms.)	lb.	.13½	.14½

THICKENERS (For Latex)

Alcogum AN-6*	lb.	.06	.06½
AN-10*	lb.	.09	.10
AN-25*	lb.	—	.31
PA-15*	lb.	.13½	.17½

THICKENERS (Cont'd)

Alcogum PA-15-B*	lb.	.13½	.17½
Betanol* (dms.)	lb.	.70	.95
CM Starch* (bags)	lb.	26.85	27.00
Gomme Labolene*	lb.	.45	.47
Good-rite K-702*	lb.	.28½	.37
K-704*	lb.	.21	.22
K-705*	lb.	.30	.39
K-707*	lb.	.18	.19
K-708*	lb.	.28	.37
K-710*	lb.	.15	.16
Hyeryl A-1000* (t.l.)	lb.	.090	.100
A-2000* (t.l.)	lb.	.335	.360
Hydroseal 3* (bags)	lb.	9.19	9.34
Melojel* (bags)	lb.	6.71	6.86
Modicol VD*	lb.	.13½	.14½
VE*	lb.	.13½	.14½
Polyco 296 BT*	lb.	.15	.16
296-N*; 530*	lb.	.15	.16
Propylene Laurate (dms.)	lb.	.57	.82
Sodium Silicate, 41°/1:3.2	cwt.	1.20	2.30
Solvitose Series*	lb.	.22	.25

VULCANIZING AGENTS

Peroxide

Di-cup	lb.	1.10	....
UC XK-1960*	lb.	5.50	—

Selenium

Vandex*	lb.	—	7.00
VA-7*	lb.	—	.50

Sulfur

Blackbirdd* (c.l.)	cwt.	—	2.90
Cloud* (c.l.)	cwt.	—	2.85
Crystex*	lb.	.19½	.23
Darex Dispersed Sulfur*	lb.	.14	.16
Devil A* (c.l.)	cwt.	—	2.45
Dispersed Sulfur	lb.	.14	.16
Insoluble Sulfur 60*	lb.	.12½	.13
Ko-Blend IS*	lb.	—	.39
Mist* (Wettable) (c.l.)	cwt.	—	4.05
Spider* (c.l.)	cwt.	—	2.85
Star* (c.l.)	cwt.	—	4.90
Sulfasan R*	lb.	—	1.55
Tire* (c.l.)	cwt.	—	2.45
Tube* (c.l.)	cwt.	—	4.90
Vultac 2*	lb.	.47	.74
3*	lb.	.51	.78

Tellurium

Telloy*	lb.	—	4.00

WETTING AGENTS

Advawet No. 10*	lb.	—	.17
No. 33*	lb.	—	.48
Aerosol 18*	lb.	.37	.42
AY*	lb.	.75	.80
MA 80%*	lb.	.40	.45
OT 75% Aqueous*	lb.	.40	.45
OT 100%*	lb.	.75	.80
OT-B*	lb.	.65	.70

WETTING AGENTS (Cont'd)

Alrosol* (dms.)	lb.	.35	.41
Airosperse*	lb.	—	.18
Anhydrol 6990* 6991*	lb.	.51	.56
Armacs*	lb.	.28	.77
Arquads*	lb.	.42	.61
Emcol 5100* (dms.)	lb.	—	.31
Energetic W-100	lb.	.28½	.35
Etho-Chemicals*	lb.	.26	.58
Ethomeen S/15*	lb.	.48	.50
T/15*	lb.	.46	.48
Kessco E-122* (dms.)	lb.	—	.45
18201*	lb.	—	.32
Kreelon 4D* (dms.)	lb.	.13	.16
8G* (dms.)	lb.	.26	.28
Kyro EO* (dms.)	lb.	—	.29¼
Modicol N*	lb.	.42½	.44½
S*	lb.	.30⅞	.32⅞
Nacconol SL* (dlvd.)	lb.	.084	.10
60S* (dlvd.)	lb.	.19	.225
Nacconol A* (dlvd.)	lb.	—	.52
Nekal WS-25	lb.	—	.38
WS-99	lb.	—	.95
Orvus AB Granules*	lb.	.16¼	.17¼
Parnol*	lb.	—	.13½
Regal Beads	lb.	.12¾	.16¾
H. D. Beads	lb.	.12¾	.15¾
Santomerse No. 3 Paste*	lb.	.26	.30
Sorapon SF-73*	lb.	—	.18
SF-78*	lb.	—	.30
Sorbit P*	lb.	—	.28
Soybean Lecithin	lb.	.13	.17
Stablex G*	lb.	.50	.90
Tergitol 4* (dms., dlvd.)	lb.	.36½	.37½
7* (dms., dlvd.)	lb.	.43½	.44½
O8* (dms., dlvd.)	lb.	.36½	.37½
P28* (dms., dlvd.)	lb.	.18½	.19
Trenamine W-30	lb.	—	.15
Vultamol*	lb.	—	.17½
Wetsit Conc.*	lb.	.35	.35

MISCELLANEOUS CHEMICALS

Aquesperse 30*	lb.	—	.11
Chiplac Paint	gal.	1.15	5.00
Copper Inhibitor No. 50*	lb.	—	1.20
D-Tac*	lb.	—	.22
Elastopar	lb.	2.05	2.07
2-Ethyl Hexanol	lb.	.23¾	.24¼
Fura-Tone Resin 1226*	lb.	.41	.43
MODX*	lb.	.38	.40
Nacconates* (dms.)	lb.	.99	3.53
Para Resins*	lb.	.04	.04½
Pigmented Filmite* (dlvd.)	lb.	.16¾	—
Resorcin, Tech.	lb.	.77½	.81½
Rio Resin*	lb.	.70	.72
Rongalite CX*	lb.	—	.21½
Sherosopes*	lb.	.13½	.18¾
Sublac Resin PX-5*	lb.	.23½	.24½
Sympep*	lb.	.54	.60
Tysonite*	lb.	.30	.30½
Vanfre*	gal.	2.45	3.00
No. 3* & No. 4*	gal.	1.95	2.00

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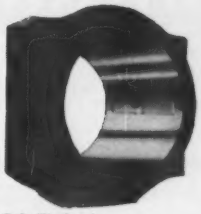

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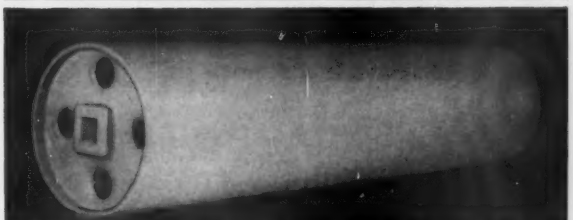

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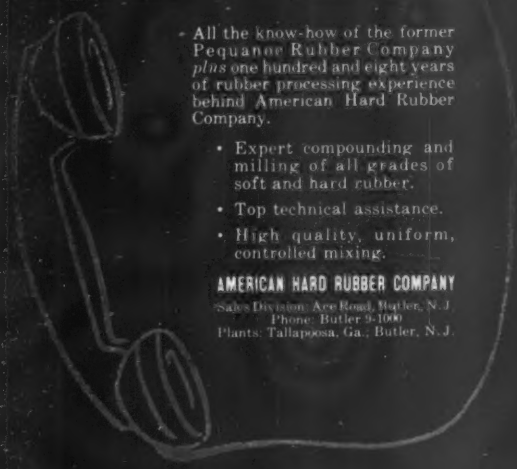

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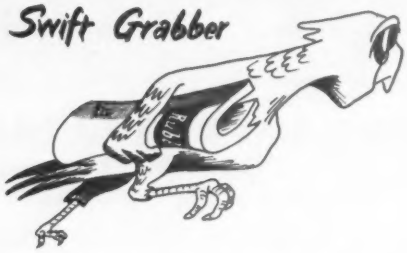

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